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ABSTRACT

This book provides 29 readings that provide a detailed overview of those elements that might take environmental education from the intuitive to the valid, to a field where there truly is a defensible, substantive structure. Contents include: (1) "Tensions in Environmental Education: Yesterday, Today, and Tomorrow" (Disinger, John F.); (2) "The Tbilisi Declaration"; (3) "Environmental Education's Definitional Problem" (Disinger, John F.); (4) "The Concept of Environmental Education" (Stapp, William B., et al.); (5) "The Status of Environmental Education with Respect to the Goal of Responsible Citizenship Behavior" (Culen, Gerald R.); (6) "Two Hats" (Hug, John); (7) "The Myths of Environmental Education--Revisited" (Hungerford, Harold R.); (8) "A Survey of the Status of State-Level Environmental Education in the U.S." (Kirk, Michelle; Wilke, Richard; Ruskey, Abby); (9) "Education Reform, Setting Standards, and Environmental Education" (Simmons, Deborah); (10) "Environmental Literacy in the United States" (Volk, Trudi L.; McBeth, William); (11) "Goals for Curriculum Development in Environmental Education" (Hungerford, Harold; Peyton, R. Ben; Wilke, Richard J.); (12) "Curriculum Development in Environmental Education for the Primary School: Challenges and Responsibilities" (Hungerford, Harold R.; Volk, Trudi L.); (13) "Environmental Education in the K-12 Curriculum: Finding a Niche" (Ramsey, John M.; Hungerford, Harold R.; Volk, Trudi L.); (14) "Integration and Curriculum Design" (Volk, Trudi L.); (15) "Comparing Four Environmental Problem Solving Models: Additional Comments" (Ramsey, John); (16) "A Technique for Analyzing Environmental Issues" (Ramsey, John M.; Hungerford, Harold R.; Volk, Trudi L.); (17) "So...You Want To Teach Issues?" (Ramsey, John; Hungerford, Harold); (18) "Assessment in Environmental Education" (Marcinkowski, Thomas); (19) "Outcome Research in Environmental Education: A Critical Review" (Leeming, Frank C.; Dwyer, William O.; Porter, Bryan E.; Cobern, Melissa K.); (20) "Predictors of Responsible Environmental Behavior: A Review of Three Dissertation Studies" (Marcinkowski, Thomas); (21) "Changing Learner Behavior through Environmental Education" (Hungerford, Harold R.; Volk, Trudi L.); (22) "The Pros and Cons of Research in Environmental Education" (Smith-Sebasto, Nicholas J.); (23) "Environmental Education and Environmental Interpretation: The Relationships" (Knapp, Doug); (24) "Evaluation of Natural Resource Education Materials: Implications for Resource Management" (Pomerantz, Gerri A.); (25) "Are We Meeting the Goal of Responsible Environmental Behavior? An Examination of Nature and Environmental Education Center Goals" (Simmons, Deborah A.); (26) "An Analysis of an Anti-Environmental Education Article: 'The Globalist Children's Crusade'" (Ramsey, John); (27) "Goals and Competencies for

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Precollege STS Education: Recommendations Based upon Recent Literature in Environmental Education" (Rubba, Peter A.; Wiesenmayer, Randall L.); (28) "The Science Education Reform Movement: Implications for Social Responsibility" (Ramsey, John); and (29) "The General Teaching Model (GTM)" (Each reading contains references.) (Hungerford, Harold R.). (CCM)

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ESSENTIAL READINGS IN ENVIRONMENTAL EDUCATION

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Essential Readings in Environmental Education

A Table of Contents

The EE Landscape

Tensions in Environmental Education:
Yesterday, Today, and Tomorrow 1

John F. Disinger

In this reading - written especially for this book - Dr. Disinger helps us take a look at the history, development, and current tensions in environmental education. For many readers, a substantial amount of what is read here will be new to them. For some of these and others, there will be disagreements - some, perhaps, based on evidence and others based on emotionally-laden perspectives concerning environmental education and what it is and should be accomplishing. In the final analysis, Dr. Disinger is quite critical of EE, especially in the formal arena. This is perhaps best described in a part of his summary when he states: "There is much room for improvement [in education], because the teacher is ethically obligated as a professional to serve as an effective educator -- a daunting task under any circumstances. In the case of environmental education, that involves facing up to the tensions inherent in the field head-on, the tensions and pressures created by society's conflicting environmental worldviews, by a poor fit for environmental instruction in the educational system, and by less-than-perfect teaching materials. It may be too much to expect the emergence of ideal environmental education all at once because teachers are as human as anyone else, but it is not too much to demand in the longer run."

The Tbilisi Declaration 13

Intergovernmental Conference on Environmental Education:
October 14-26, 1977

The Tbilisi Declaration is considered to be one of the most important seminal documents in environmental education. Key elements of The Tbilisi Declaration are contained in this reading. Due to space limitations, the original has been abridged. Those wishing to read the entire document are referred to *Connect*, the UNESCO/UNEP Environmental Education Newsletter, Vol. III, No. 1 (January 1978).

Environmental Education's Definitional Problem 17

John F. Disinger

This article by Dr. John Disinger was prepared as an attempt to examine the various definitions related to environmental education at the time. Although written for publication in 1983, its message continues to hold meaning for environmental education scholars everywhere. It most certainly helps the individual understand something of the roots of environmental education and helps better define what EE is and what it is not. This alone makes it an important contribution to the field. For those interested in the history of EE, this reading will have special import. (A 1997 Epilogue follows this article's reference list.)

The Concept of Environmental Education 33

William B. Stapp, et al.

No book of EE readings would be complete without this article as a component part. It is an environmental

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education classic. In this article, Dr. Stapp and his associates develop a considered definition of environmental education - a definition which is very consistent with many of those one finds in the literature today. Given that this article was published in 1969, one wonders why in the world other scholars debated so vociferously about a definition for environmental education. Even other excellent definitions which do the field justice, e.g., the EPA definition found elsewhere in this book, do little more than take the reader further into the substantive structure of the field. In this dimension at the very least, Dr. Stapp was far ahead of his time.

The Status of Environmental Education with Respect to the Goal of Responsible Citizenship Behavior 37

Gerald R. Culen

In this original article, Dr. Culen elaborates on the goals of environmental education with special attention given to issue instruction and the ultimate goal of EE instruction, i.e., promoting responsible environmental behavior. The variables associated with environmental behavior are also examined along with the instructional applications/methodologies used to develop in learners the skills needed for responsible environmental behavior. This reading and the associated synthesis provide research support for the continued development of curricula which encourage responsible environmental behavior.

Two Hats 47

John Hug

Two decades ago John Hug wrote this very short and extremely meaningful "editorial" as a preconference paper for the North American Regional Seminar on Environmental Education for the Real World. What makes this reading important are the following: (1) there is still some debate as to whether environmental educators should be environmentalists under the same umbrella that they wear professionally, and (2) the writer focused an operational definition of an environmental educator squarely where it belonged. Seldom has so much been said in so short a space!

The Myths of Environmental Education - Revisited 49

Harold R. Hungerford

Myths surround many human endeavors and environmental education is no exception. Over two decades ago Dr. Hungerford wrote the original "Myths of Environmental Education" for The Journal of Environmental Education (Vol. 7, No. 2, Winter 1975, pp. 21 -26). In that article Dr. Hungerford discussed what he believed to be some of the most prevalent myths of the day. In his opinion, many of these myths continue as the year 2000 approaches. Not too surprisingly, some of these myths need additional comment and new myths have emerged. In the reading - written in the first person - some of the original article remains, but it is substantially revised and abridged with new material added.

A Survey of the Status of State-Level Environmental Education in the U.S. 57

Michelle Kirk, Richard Wilke, and Abby Ruskey

The data for this study were collected in 1995 and 1996. Thus, the results are relatively current in terms of this book's copyright date. The purpose of this study was to obtain information about the status of comprehensive state-level environmental education programs in the United States. The researchers felt that comprehensive state-level EE programs consist of a combination of program, structure, and funding components. They found that no state currently has the 16 components of what the writers identify as a comprehensive program.

Environmental Literacy

Education Reform, Setting Standards, and Environmental Education....................67

Deborah Simmons

This article was written for this book of readings at the request of the editors. The topic of "standards" is so very important to the field of environmental education that it needs to be thoroughly discussed in a book of this kind. In this piece, Dr. Simmons discusses, among other things, the need for standards, the origin of standards, and the relation that should exist between standards and an overriding goal of environmental literacy.

Environmental Literacy in the United States: 75

Trudi L. Volk and William McBeth

This document was originally written as a white paper at the request of The Environmental Education and Training Partnership in 1996 with funding provided by the US Environmental Protection Agency. Its purpose was to explore the concept and status of environmental literacy as it applies to education within the United States. Further, it was to make specific recommendations concerning environmental literacy and how it might be measured across US learner populations in the future.

Environmental Education Curricula

Goals for Curriculum Development in Environmental Education 89

Harold Hungerford, R. Ben Peyton, and Richard J. Wilke

In this reading, the authors take a hard look at the field of environmental education and synthesize a set of goal statements for curriculum development in the field. Using the Tbilisi Declaration as a basis for establishing a substantive structure for EE, Drs. Hungerford, Peyton, and Wilke determined that goals for the field could be placed in four rather hierarchical goal levels: (I) An Ecological Foundations Level; (2) A Conceptual Awareness of Issues and Values Level; (3) An Issue Investigation and Evaluation Level; and (4) An Environmental Action Skills Level. Although this article appeared in the Spring 1980 edition of *The Journal of Environmental Education*, the goals continue to receive a good deal of attention by professionals who want to develop materials based on a sound scope and sequence of content and activities.

Curriculum Development in Environmental Education
for the Primary School: Challenges and Responsibilities 99

Harold R. Hungerford & Trudi L. Volk

In this paper, Drs. Hungerford and Volk present a number of findings and ideas important to the curriculum development arena: (1) they identify problems which have often resulted in the development of curricula that might not be sound; (2) they list guidelines that they feel must be followed when developing an effective environmental education curriculum; (3) they present a set of goals which can be used for curriculum development if the developers want to produce responsible citizenship behavior; and (4) they list and discuss a number of critical components that must be observed in a completed curriculum which focuses on environmentally responsible behavior.

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Environmental Education in the K-12 Curriculum: Finding a Niche 111

John M. Ramsey, Harold R. Hungerford, and Trudi L. Volk

In this 1992 article, the authors told the reader that significant progress had been made in the United States regarding environmental decision making by the government, businesses, households and individuals. However, there appeared to be no parallel trend in the nation's K-12 schools. The situation remains largely unchanged today. In addition, this reading reviews the basic precepts of environmental education, summarizes state-level efforts directed at its establishment, and makes suggestions for systematically incorporating it into the K-12 curriculum. One of the very significant features of this reading is the rather detailed tables which show what concepts/skills could successfully be infused into existing courses across the middle school years.

Integration and Curriculum Design 125

Trudi L. Volk

In this important reading, Dr. Volk details what it takes to produce a successful environmental education curriculum, if one wants to see changes in overt environmental behavior. In order to understand the complexities involved, she communicates what we know about what goes into responsible citizenship behavior and how these components would be reflected in a successful curriculum. In addition, she tells us how to evaluate existing curricula and what steps are needed as one plans for the successful implementation of new instructional programs.

Comparing Four Environmental Problem Solving Models:
Additional Comments 145

John Ramsey

In this reading, Dr. Ramsey discusses the four major environmental problem solving (EPS) approaches in use today. He looks at these in terms of their applicability to modern or postmodern perspectives as well as their relation to constructivist theory. He also compares them in terms of whether they exist as curricular models or simple instructional techniques. He then discusses the utility of each with respect to being able to function effectively in today's educational climates as well as its influence on the development of responsible citizenship. Dr. Ramsey poses a number of truly critical questions and attempts to answer each succinctly and without mincing words. We suspect that this reading will stimulate a great deal of discussion in the educational community.

Environmental Education Instruction

A Technique for Analyzing Environmental Issues 157

John M. Ramsey, Harold R. Hungerford, and Trudi L. Volk

Teaching students to deal effectively with issues is a critically important component of environmental education. However, complex environmental issues are often very confusing for students. The issue analysis technique presented here allows learners to organize information about an issue in a sound conceptual manner and without bias. In so doing, students will better understand what the authors sometimes refer to as "the anatomy of issues."

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So . . . You Want to Teach Issues? 163

John Ramsey and Harold Hungerford

The basis for this reading appeared originally in the Spring 1989 issue of *Contemporary Education*. Although its focus was on what were called "science-related social issues" or a synonym "STS issues" the article appears here because all environmental issues are also science-related social issues. There is simply no escaping that fact, because all environmental issues have both a science component and a social component. Therefore, this reading is as important for environmental educators as it was for science educators. In this reading, Drs. Ramsey and Hungerford define science-related social issues, provide some options for the teacher who wants to help students learn about these issues, state what the outcomes of instruction should be, and communicate two different models which are available for providing instruction in science-related social issues.

Evaluation

Assessment in Environmental Education 171

Thomas Marcinkowski

The original manuscript for this particular reading was a document written by Dr. Marcinkowski for the *Environmental Education Teacher Resource Handbook* published by Kraus International Publications in cooperation with the National Science Teachers Association in 1993 (pp. 144-197). The reading that appears here, which resulted from this manuscript, introduces the reader to concepts associated with measurement, testing, assessment, and evaluation. In addition, it focuses the reader's attention on a goodly number of ideas associated with these concepts and educational practices as well as guidelines for applying these practices in environmental education.

Environmental Education Research Topics

Outcome Research in Environmental Education:
A Critical Review 209

Frank C. Leeming, William O. Dwyer,
Bryan E. Porter, and Melissa K. Cobern

In this landmark study, the authors included an analysis of the 34 environmental education studies published since 1974 that attempted to demonstrate changes in environmentally relevant knowledge, attitudes, or behaviors. The writers divided the studies into two major categories -- in-class and out-of-class programs -- and critiqued the studies' findings and methodologies. Although many of the investigations contained methodological difficulties, some of the findings indicated that future research could refine environmental education strategies and curricula.

Predictors of Responsible Environmental Behavior:
A Review of Three Dissertation Studies 227

Thomas Marcinkowski

In this reading, Dr. Marcinkowski takes the reader on a journey through what environmental educators think and theorize about REB (Responsible Environmental Behavior). The author delves into three major studies dealing with the predictors of REB and then provides a detailed discussion of the implications and impacts of these studies. Although this reading is not for the faint-of-heart, it provides, for the first time, a detailed look at three very closely related studies completed by Drs. A. P. C. Sia, Dan Sivek, and Tom Marcinkowski himself, mostly in the decade preceding the '90s. This body of research has enormous implications for practice in the field of EE

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and should be looked at closely by anyone involved in environmental philosophy, instructional design and/or curriculum development in environmental education.

Changing Learner Behavior through Environmental Education 257

Harold R. Hungerford and Trudi L. Volk

This is an article on research into responsible environmental behavior that has become something of a classic in the field of environmental education. In this reading Drs. Hungerford and Volk probe in some depth the research that has led to a refined model illustrating the variables which seem to be associated with citizenship behavior in EE. Having displayed and discussed this model of major and minor variables involved in environmental citizenship behavior, they identify a number of critical educational components in any instructional program which have been shown to impact on learners' citizenship behavior. They then present two different instructional models which have been shown effective in promoting responsible citizen behavior. This is followed by three major concerns held by the authors for the field which are related to the subject of the paper itself.

The Pros and Cons of Research in Environmental Education 273

Nicholas J. Smith-Sebasto

In this paper, Dr. Smith-Sebasto provides his assessment of the state of environmental education research. He considers areas that expose the field to criticism as well as those areas that strengthen the mission and provides recommendations about research needs that should move the field forward.

Nonformal Environmental Education Instruction

Environmental Education and Environmental Interpretation: The Relationships..293

Doug Knapp

In this article, Dr. Knapp takes the reader into a thorough discussion of the relationships that exist between environmental interpretation and environmental education. The similarities and the differences are important to both endeavors. More important, perhaps, is the notion that the two fields are perfectly compatible and that cooperative ventures are highly recommended. In this vein, examples are given which invite the reader to consider similar projects/programs.

Evaluation of Natural Resource Education Materials: Implications for Resource Management 301

Gerri A. Pomerantz

In this interesting and significant study, natural resource education materials for the elementary level were evaluated by the researcher to determine their emphasis on educational content and instructional goals. The majority of materials addressed basic knowledge of ecological principles. Few of these materials helped students develop the critical thinking skills and behaviors which are necessary for them to go from awareness to knowledge to environmental action. Overall, there appeared to be minimal coverage of resource management issues and the higher order instructional goals of analytical skill development and [responsible] environmental behavior. The author also identified the strengths and weaknesses of the lessons and related these to the achievement of environmental education and natural resource management goals.

Are We Meeting the Goal of Responsible Environmental Behavior?
An Examination of Nature and Environmental Education Center Goals 311

Deborah A. Simmons

In this important research study, Dr. Simmons strove to determine the extent to which nature and environmental education centers were meeting generally accepted goals of environmental education and especially the goal of developing responsible environmental behavior. In her discussion she states, ". . . there is considerable resistance [on the part of the centers] to supporting the goals of influencing people's attitudes, disseminating information about local environmental issues, or even helping people develop environmental problem-solving skills. . . . how can a center enable people to act in an environmentally responsible way unless they are provided with the necessary set of tools?" (A 1997 Epilogue by Dr. Simmons follows the references in this reading.)

A Potpourri

An Analysis of an Anti-Environmental Education Article:
"The Globalist Children's Crusade" 321

John Ramsey

In this 1997 reading, Dr. Ramsey critiques an article that is extremely critical of environmental education. The article, "Globalist Children's Crusade" attacks EE from a number of standpoints. Dr. Ramsey states that, "The [article's] theme appears to be that EE is unscientific, parent-bashing, secular religious, globalist and Big Government propaganda that indoctrinates children into a deep commitment of environmentalism." Interestingly, Dr. Ramsey also points out that the research indicates that there is no national commitment to environmentalism on the part of the nation's youth. Be that as it may, it is most interesting to observe how Dr. Ramsey is able to redress the attack on EE while, at the same time, acknowledging that environmental education and its practitioners are not at all perfect.

Goals and Competencies for Precollege STS Education:
Recommendations Based upon Recent Literature
in Environmental Education 327

Peter A. Rubba and Randall L. Wiesenmayer

In this article, Drs. Rubba and Wiesenmayer compare STS instruction with a goal structure for environmental education. Noting substantial goal similarities, they construct a set of goals for precollege STS education based on The Goals for Curriculum Development (1980) and the research which followed that theoretical model (much of which is discussed in this readings book). As the authors state, ". . . learners are most likely to become active in the resolution of STS issues if the STS education they receive includes the study of issue investigation skills and strategies that can be applied toward the resolution of STS issues along with the opportunity to apply them." This is in complete agreement with the research which has been conducted into issue investigation and evaluation outcomes in EE.

The Science Education Reform Movement:
Implications for Social Responsibility...337

John Ramsey

That every environmental issue is also an STS issue makes this article by Dr. Ramsey extremely important for environmental educators. Although much has been written in EE about citizenship behavior, we do not see a great deal about fundamentals of social responsibility, notwithstanding other topics which typically exist on the periphery of EE. Dr. Ramsey makes some rather cogent points that some educators are often prone to forget.

He writes: " All science students, however, will become citizens. All will be consumers of the products and services of science and technology. All will assume and be responsible for the benefits and risks of scientific and technological knowledge, products, systems, and services. All will be decision makers concerning matters of science and technology, either willfully via participation in democratic decision making or apathetically via the lack of such participation. . . . [science] education . . . is a socially driven enterprise and part of an educational system with a larger, democratic mission. . . . STS issues-based instruction has attempted to construct an appropriate means to achieve the much-sought end of social responsibility."

The General Teaching Model (GTM) 355

Harold R. Hungerford

The General Teaching Model is important to this book of readings because it serves as a heuristic device which can help instructional planners develop valid instruction for both formal and nonformal learners of all ages, K - adult. It is included here in order to help those people in the field of EE who want to prepare valid instructional materials. It provides the developer with a superior template from which to work. The GTM has proven valuable to curriculum developers and workshop leaders for over two decades.

The earth as a life-support system is deteriorating. This the reader must understand clearly, in case he hasn't noticed or has been persuaded otherwise. In some respects our children's world will be better than ours, but on balance it will be uglier, less interesting, and more dangerous. This is not a pleasant fact to face, but denial is not a sufficient response to the problem.

R. Thomas Tanner

About the Authors

Melissa K. Cobern earned an M.S. degree from The University of Memphis and is now a full-time Park Ranger. She is actively engaged in the protection of our natural resources.

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. . . environmental education programs can be used to meet discipline-based standards. Because environmental education is by its very nature interdisciplinary, it can help students meet the high standards set by the traditional school disciplines (e.g., science, mathematics, geography, history).

Bora Simmons, 1997

Preface

When one looks for a book of readings in any field, that person would typically look for breadth and thoroughness of coverage. The editors of these twenty-nine readings in this particular book make no such claim. Although there is some breadth and a good deal of thoroughness, there also resides between these covers a rather sharp focus. This focus tends to examine the tremendous need for validity in a field that tends often to be intuitively driven. It is in this book that one can find a rather detailed overview of those elements that might take environmental education from the intuitive to the valid - to a field where there truly is a defensible substantive structure - one which has already been validated in a number of ways.

Alternatively, there will undoubtedly be cries of bias on the parts of some readers. Indeed, such a cry will be justified and the editors make no apologies. However, said cries, delivered in what might well be an intellectual vacuum, could quite possibly avoid mentioning the very apparent wealth of resources cited in the many lists of references and bibliographies found here. These lists are often broadly based and take the reader to many other philosophies, studies, and countries. Here one can find much of the remainder of the literature in environmental education and in other areas as well, e.g., assessment, instruction, and curriculum.

Thus, what is found here is a book that attempts to take the reader from strong criticisms of the field to equally strong statements of philosophy as well as some of the best research ever conducted in environmental education. The editors and authors of invited papers hope that this book will serve as a basis for discussion and debate in both undergraduate and graduate programs. They also believe that many of the modern-day critics (and advocates) of environmental education would be well advised to visit this book and come away knowing that scholarship does have a role in the field and that the scholars can both criticize and defend a truly important educational enterprise.

I want to take this opportunity to thank many of the wonderful people who have worked so hard to make this book a success. Bob Watts at Stipes Publishing Company gets rave reviews - as usual - because of his unceasing loyalty to our work and publications. No questions were asked when he was approached about the printing of this book. A guarantee of publication was given even before a single article was formatted. In terms of the editorship for this book, Bill Bluhm also gets rave reviews due to his tireless editing and assistance with the formatting. This book would probably not exist had it not been for his contributions. Needless to say, Trudi Volk and John Ramsey also contributed to whatever excellence appears here both in terms of criticism along the way and direct contributions to the literature found here.

John Disinger - friend, associate, supporter, EE elder and winner of NAAEE's prestigious Walter Jeske Award - contributed mightily to this book. Many were the Email messages and envelopes that passed between us. His willingness to write a seminal piece for this book was also appreciated far more than he might realize.

I also want to acknowledge my good friend Bill Stapp whose contributions to environmental education are legendary. When asked to contribute materials ancillary to his now famous article on the concept of environmental education, he was quick to respond in the most positive manner. We thank him greatly. This is a far better book because of him.

Professionals who sacrificed of their own time to make contributions to this book are many. Among them are Bora Simmons who has two contributions here - actually three with the epilogue that appears with one of her writings. Jerry Culen, who is always busy at the University of Florida, did his usual yeoman's work in putting together a piece on the status of environmental education with respect to responsible citizenship behavior. Tom Marcinkowski - one who is perpetually in work-related overload - gave of his valuable time to write the article on the research focused on the precursors to responsible citizenship action. Nick Smith-Sebasto, likewise buried with work much of the time, took even additional time from his family and friends to write the piece of the status of research in environmental education. Doug Knapp, another prisoner of work and commitment, did the same and produced a fine writing which takes a look at the similarities and differences between environmental education and environmental interpretation.

Professionals who had already contributed to the literature and have been reprinted here will be commented on in the section devoted to the authors and, in some cases, in the editorial notes which accompany each reading. The editors thank them all!

Harold R. Hungerford, September 23, 1997

Tensions in Environmental Education: Yesterday, Today, and Tomorrow

John F. Disinger

In this reading - written especially for this book - Dr. Disinger helps us take a look at the history, development, and current tensions in environmental education. For many readers, a substantial amount of what is read here will be new to them. For some of these and others, there will be disagreements - some, perhaps, based on evidence and others based on emotionally-laden perspectives concerning environmental education and what it is and should be accomplishing. In the final analysis, Dr. Disinger is quite critical of EE, especially in the formal arena. This is perhaps best described in a part of his summary when he states: "There is much room for improvement [in education], because the teacher is ethically obligated as a professional to serve as an effective educator -- a daunting task under any circumstances. In the case of environmental education, this involves facing up to the tensions inherent in the field head-on, in addition to the tensions and pressures created by society's conflicting environmental worldviews, by a poor fit for environmental instruction in the educational system, and by less-than-perfect teaching materials."

In 1971, a group of community college educators undertook the development of instructional materials for use in two-year colleges. Their topic was then-contemporary environmental problems. As a part of their development/marketing/dissemination scheme, they initiated a formal organization of their members and sought to broaden participation by inviting other community college educators to join. Since their focus was on education about the environment and their intended geographic scope was the United States, they selected as their organization's name the National Association for Environmental Education (NAEE).

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Intention and Actuality

Those founders had no intention of extending their association's membership beyond individuals whose interests were closely parallel to their own -- the development, marketing, and dissemination of instructional materials dealing with the environment, for use at the community college level. They were surprised when individuals from all educational levels representing a variety of formal and non-formal orientations showed up at their conferences, took out membership, and quickly attempted to re-direct the organization by expanding its mission to venues and levels well beyond the community college classroom.

Others who showed interest in the emerging association included a broad range of environmental activists who felt that an organization focused on "education" could and should afford them open opportunity to disseminate their pro-environmental messages to the full range of educational audiences. Those messages were sometimes (but not always) more propaganda than education. Also entering the mix were employees of governmental agencies

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whose missions included environmental and natural resources management. They saw education as a way of furthering their agencies' management objectives; they believed that an environmentally knowledgeable public that understood what an agency was charged to do, and why, would support the agency in the accomplishment of its mission. Yet another group was made up of representatives of businesses and industries intent on clarifying and/or justifying their positions on environmental issues. The community college people resisted these incursions valiantly, but ultimately unsuccessfully; they lost control of the association they had founded. Because the organization no longer served their original purposes, most of them ultimately left it.

Where had those community college educators -- intelligent, honorable, highly professional individuals with an admirable mission and a clear concept of purpose -- gone wrong? The answer is obvious -- in the choice of name for the organization. At the time, there was no open membership organization in North America designed specifically for individuals pursuing a rapidly emerging interest, environmental education, so an association incorporating that name in its title was bound to attract attention from many quarters. It is true that, at that time and since, a number of existing organizations demonstrated professional educational interest in the environment -- the American Nature Study Society, the Association of Interpretive Naturalists, the Conservation Education Association, the National Science Teachers Association, and the Outdoor Education Association, to name a few -- but none had a name that indicated a specific focus on education about the environment per se. Indeed, the name of each of those associations made it clear that its primary reason for existence was for a somewhat different purpose. Most simply and tellingly, none of them contained the word "environment" in its title.

How were those looking for an organization focused broadly on environmental education to know that a broad focus was not the intended purpose of the NAEE? It seemed not to matter how clearly the community college people explained what their organization was intended to be; the simple fact was that its name was all-encompassing, and thus was perceived as an open invitation to many comers. And so those others came -- not all of them, but a variety of individuals who felt that their interests and missions could and would be served by participation in an organization of people whose professed primary concern was "environmental education" (1).

A Mirror of the Times

Since 1971, the National Association for Environmental Education has changed its name once, to the North American Association for Environmental Education (NAAEE), and its primary focus several times, as those many types of individuals -- teachers and teacher educators, conservationists and conservation educators, naturalists and nature educators, scientists and science educators, recreationists and outdoor educators, resource and environmental managers, environmentalists, and business/industry public information specialists -- have tried, sometimes successfully, both to work effectively with one another and to advance their own interests in the context of environmental education (2). In attempting to accomplish the latter, they have also become both creators and victims of tensions manifested in philosophical debates, practical confrontations and, more than occasionally, strategic and/or face-saving avoidance.

Since 1971, the National Association for Environmental Education has changed its name once, to the North American Association for Environmental Education (NAAEE), and its primary focus several times . . .

In many ways, NAEE's experience mirrors the North American history of the movement called "environmental education" to this point in time. From the outset its most obvious problem has been semantic; those approaching environmental education from its several dramatically different perspectives are likely to say the same words when they mean different things; apparently unknowingly, they have talked past each other since the field was named, and continue to do so. These difficulties with language are actually indicators of striking contrasts in viewpoints, illustrated clearly by very real dissimilarities in two different sets of worldviews -- one concerning the "proper" relationships between humans and the rest of the environment, the other about what education is, is not, should be, and should not be. External pressures, from other educators and from representatives of the full range of environmental perspectives, continue to compound the situation and intensify tensions both within and about the field.

These tensions have impacted environmental education since its beginnings, continue to buffet it today, and show no signs of diminishing. This paper reviews the status of interactions between and among competing agendas associated with diverse environmental worldviews, along with contrasting perceptions of what education is and should be.

Environmental Worldviews

Cornucopian, utilitarian conservationist, and preservationist are convenient labels for three very different worldviews on the relationships between humans and the rest of the natural world (3). These perspectives fall along a continuum ranging on one extreme from a (cornucopian) view of unlimited and unregulated use of the environment, based on an operational assumption that the natural world contains an effectively unlimited supply of natural resources and is functionally capable of absorbing unlimited quantities of waste materials without suffering substantial damage, to a polar opposite (preservationist) perspective according to which the world should be left to its own devices to function according to the laws of nature, with effective elimination of human impacts. Preservationists generally believe that if humans manage the environment at all, that management should be toward maintenance of the natural world in a pristine state. Similar to but not the same as preservationists, environmentalists opt for managing the environment in such a manner that all negative effects by humans will be avoided and/or completely redressed (4).

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The utilitarian conservationist perspective is somewhere in between, though not necessarily in the middle or always in the same place. Utilitarian conservationists recognize limits to the capacity of nature to produce goods and to absorb wastes; they endorse the scientific management of the natural world so that both natural resource usage and environmental quality are optimized in terms of potential for human use and benefit over theoretically unlimited time ranges. Thus, utilitarian conservation focuses on the needs and wants of humans, but recognizes the necessity for "enlightened management" so that the natural world, and the environment, continue to provide needed and desired resources and viable environmental conditions in a sustainable manner.

Both the cornucopian and utilitarian conservation perspectives are succinctly described, though not by those names, in the first chapter of the Book of Genesis of the Judeo-Christian Bible, and thus have the advantages of being culturally entrenched in Western thought and practice. The cornucopian position typically is traced to Genesis I by both its supporters and its critics; the utilitarian conservation position is less frequently identified with that source, though part of the chapter indicates that the role divinely assigned to humans is to function as "God's gardeners" by caring in a responsible -- and productive -- manner for all of creation. Though some expressions of the preservationist worldview appear in the Judeo-Christian Bible, that perspective is more likely to be associated, often somewhat romantically and generally in an idealized fashion, with non-Western religions, including most prominently those of American Indians and of the Far East (5).

Environmentalism and Environmental Education

Because they are human, teachers and other communicators (6) are products of and in constant interaction with the cultures in which they were brought up and in which they live. Thus, individual teachers are as likely as anyone to espouse one or another of these three worldviews, or of some variant of one or more of them. Also like most other humans, they are not terribly likely to have studied them conscientiously or thought them out rigorously; it is quite possible that they, like other people, have grown up with particular environmental worldviews and accepted them at face value, essentially as truisms. It is, of course, also possible that what they learned during their own formal, non-formal, and informal educational experiences shaded their initial environmental worldviews, or even changed them drastically and dramatically (7). In any case, their environmental worldviews, lying somewhere along the continuum from cornucopian to preservationist, are typically based on something less than complete information and rigorous critical analysis.

Regardless of their educational backgrounds and their general attentiveness to matters of public

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concern, teachers are as unlikely as anyone to be well versed in the intricacies of environmental matters, particularly in terms of comparing and contrasting the multiple perspectives brought to bear upon them by the various holders of the multi-shaded spectrum of environmental worldviews. But teachers are in a different situation than are other people; by virtue of their positions they have extensive influence on the current generation of students. Therefore, they are professionally obligated to tell it like it really is -- not how the individual teacher thinks it should be. Ultimately, this obligation must involve in-depth presentation and analysis of all sides of environmental issues (8). To be able to do this teachers must understand the issues themselves and also understand the environmental worldviews of all the players on all the sides. Because they must do their teaching within existing educational systems, their problem is severely compounded.

It is an unfortunate fact that educational systems are not generally designed to present without bias all sides of environmental issues, any more than they are organized so that they present all the background information organized in the manner necessary to assure understanding of the complexities involved (9). Pre-service and in-service training of teachers has not been particularly successful in providing for the development of thorough understanding of the scientific and technical aspects of environmental issues, nor has it done well in placing those aspects in the social-political-cultural settings in which they occur. But then, neither has college/university education placed a priority on accomplishing this analysis of interactions in general for any of its student clientele, nor do social, political, and cultural institutions appear to be focused on, or adept at, doing so for citizens in general.

The continuing debate -- should teachers learn what to teach or how to teach? -- is hopelessly simplistic; teachers need to learn both. But, with respect to interdisciplinary environmental issues, it is apparently impossible for them to do that in a four (or five) year pre-service program, and at best difficult even with additional study through graduate and/or in-service programs. Content-oriented academic programs, for teachers as for others, typically focus on specific disciplines with little priority attention to interdisciplinary ramifications. Particularly insidious is a lack of in-depth study of the natural and physical sciences by social science majors, and a corresponding paucity of attention to the social sciences by natural and physical science majors. Making matters more complicated, those preparing to be middle - or secondary-school teachers do not pursue balanced programs in both natural/physical and social sciences, while those preparing to become elementary school teachers are unlikely to pursue either the natural/physical sciences or the social sciences in depth, if at all.

There are few role models available to the teacher of environmental topics, if he or she is looking for someone who presents a balanced, rigorous treatment of the range of environmental perspectives; Renaissance men and women are in short supply, especially those espousing a teaching philosophy whereby the full range of environmental worldviews all receive rigorous, objective, balanced treatment.

Tensions Caused by Environmental Perspectives

There are few role models available to the teacher of environmental topics, if he or she is looking for someone who presents a balanced, rigorous treatment of the range of environmental perspectives; Renaissance men and women are in short supply, especially those espousing a teaching philosophy whereby the full range of environmental worldviews all receive rigorous, objective, balanced treatment.

Similarly, few educational materials are designed for the purpose of providing a rigorous, objective, balanced examination of all sides of environmental issues; value-neutral educators (if there are any) don't design them, and other producers of materials typically endorse the particular perspective they wish to promulgate by slanting their "educational" presentations accordingly. There are many materials that make strong cases for one perspective or another; some have been designed by environmental organizations, some by resource management agencies and organizations, and some by business/industry groups. Some are scientifically sound, some are not; some are blatant propaganda, some are not; in these respects, it does not appear to make much difference whether they were sponsored and/or prepared by environmental activists, by utilitarian conservationists, or by cornucopians (10). Nevertheless, just as it is understandable that the sponsors of materials have their own agendas and their own reasons for preparing instructional materials, it is important to point out that such materials, although they typically endorse particular environmental perspectives, may still be useful for instructional purposes. Criteria of appropriateness include:

- At least implicitly, the materials make it clear that they are written from a particular perspective;
- The materials are grounded in sound science, both natural/physical and social; and
- The materials do not promote the taking of proactive positions on issues that students do not understand.

There are few role models available to the teacher of environmental topics, if he or she is looking for someone who presents a balanced, rigorous treatment of the range of environmental perspectives; Renaissance men and women are in short supply, especially those espousing a teaching philosophy whereby the full range of environmental worldviews all receive rigorous, objective, balanced treatment.

The instructional use of materials endorsing any particular environmental perspective creates a substantial problem for the teacher: how can he or she offer a balanced perspective while using "unbalanced" materials? The several possible "right answers" to this question, none of them sufficient in itself, include parallel use of materials presenting contrasting perspectives on the same issue, presentation by the teacher of "devil's advocate" perspectives sharply contrasting with those of the materials, encouragement of student investigations and comparisons of contrasting perspectives, and rigorous analysis of the natural/physical and social science realities underlying the issue. All of these, of course, place special demands on the teacher in terms of his/her own intellect, background, preparation, and tolerance for both ambiguity and for worldviews different from his/her own. It may be that teachers need to be more intellectual, more understanding, more realistic, and more tolerant than the nation's social, economic, scientific, educational, and political leaders in presenting rationally and fairly the diversity of worldviews impacting on human relationships with environment, and the tensions between and among them.

Tensions Caused by Educational Perspectives

In addition to an intellectual context marked by tensions created by contrasting worldviews that result in incompatible expectations, environmental learning must take place in an educational/institutional context that is not particularly benign. The field itself is poorly defined, in the sense that some educational practitioners have attempted to preempt the term as a new name for what are more accurately labeled predecessors of environmental education -- outdoor education, conservation education, and nature study. In doing this, they are effectively pouring old wine into a new bottle (11).

In any case, environmental education clearly does not "fit" in normal educational settings. First and foremost, environmental education is by its nature interdisciplinary, but neither school organizational patterns nor teacher certification programs (for high schools and middle schools) make allowance for anything that is not tied to one of the established disciplines. There is at least as much logic in associating environmental education in schools with the social studies as with the natural/physical sciences, but the way that environmental education has evolved has made that impractical (12). Thus, a major tension is unavoidable: some aspects of environmental education fit into existing curricula as science, and some as social studies, but the two are not coordinated with one another. Furthermore, the complete environmental education package cannot appropriately be labeled a subheading under either science or social studies, or of any subject area, but the educational system is unable to adjust to that. Further, no one believes that there is room to add a new subject, environmental education, to the curriculum.

In the United States, the common wisdom is that environmental education is best infused into the curriculum -- inserted in modules, packets, pieces, even single lessons -- where it best fits. This is the pragmatist's position, and from his or her point of view a workable one. As a matter of fact, it is functional; the environment, and environmental concerns, abound with convenient, striking examples that can illustrate key concepts in many other subject areas. Thus, much environmental teaching and learning take place in science and social studies classes -- and in English, math, and many other subject area classes. However, this is frequently on a "catch-as-catch can" basis. Whatever it is, it is neither sequential nor cumulative; it does not build logically or rigorously on environmental concepts. It also is unlikely to afford balanced considerations of multi-dimensional issues.

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Summary

Educators who deal with environmental concerns are caught in several "middles" (13). Particularly troublesome is the inability of American society to decide what their schools are for. Oversimplifying this concern leads to its reduction to a pair of either-or questions: Do schools exist to perpetuate the current culture by teaching the in-school generation the wisdom (and the worldviews) of the past and present? Or do schools exist to serve as agents of political-social-cultural change?

The schools, and the teachers in the schools, are the object of pressures from preservationists/environmentalists, utilitarian conservationists, and cornucopians to include and feature their positions while soft-pedaling or excluding others. The subject matter of environmental education does not "fit" well in either the natural/physical sciences or the social studies. Teacher educational backgrounds are unlikely to be as extensive as they should be, considering the depth and breadth of material they are dealing with. Many of the teaching materials available to them are suspect at best. Further, teachers of environmental education must be educational pragmatists at the same time as they are theoretical idealists -- the educational ideal, not the environmental ideal. Their job is to teach about the environment so that their students understand it as it is, and will be, and might be, and how what they do individually and collectively affects it.

When all is said and done, environmental education is currently in schools to the extent that teachers want to include it strongly enough to find ways to do so. Generally (not always) those teachers are science teachers, but quite often they are social studies teachers. Less frequently, other teachers pay significant attention to environmental concerns in their classes. When teachers of self-contained elementary classrooms become involved in environmental education, it is typically under the heading of science, or sometimes of social studies.

. . . teachers are as unlikely as anyone to be well versed in the intricacies of environmental matters, particularly in terms of comparing and contrasting the multiple perspectives brought to bear upon them by the various holders of the multi-shaded spectrum of environmental worldviews.

In any case, it probably is fair to say is that, generally speaking, neither science teachers nor social studies teachers, nor any teachers, are well prepared to deal instructionally with controversial issues. Their own backgrounds and worldviews, their teacher preparation programs, and their lack of experience in teaching and learning in an interdisciplinary manner all mitigate against it. Most teachers have not been trained for environmental education, and the environment-focused instructional materials available to them place little priority on substantive natural science/social science background and/or critical analysis of multiple positions. Indeed, it is a wonder that teachers do as well as they do.

There is much room for improvement, because the teacher is ethically obligated as a professional to serve as an effective educator -- a daunting task under any circumstances. In the case of environmental education, this involves facing up to the tensions inherent in the field head-on, in addition to the tensions and pressures created by society's conflicting environmental worldviews, by a poor fit for environmental instruction in the educational system, and by less-than-perfect teaching materials. It may be too much to expect the emergence of ideal environmental education all at once because neither our educational systems nor our socio-political-economic systems are perfect, and also because teachers are as human as anyone else. Still, it is not too much to demand that ideal in the longer run. After all, teachers must be competent educators to teach their students how the world is and might be, and the ramifications of various human interactions with and within it; at the same time, teachers must work with their students to develop their analytical, critical, and creative thinking skills, along with their communication skills (14). Ethically and professionally, teachers cannot be propagandists for any worldview, pro-or anti-environmental, pro- or anti-development, nor should they teach their students to be.

Endnotes

1. One of the strongest criticisms of environmental education is that it has been, and still is, biased toward pro-environmental positions, encouraging students to engage in proactive environmental behavior on emotional, sometimes false, sometimes irrational bases while failing to provide sufficient scientific/economic background information on environmental issues to justify positions taken (see, for example, Sanera and Shaw, 1996). Coyle (1996) challenged this assertion by pointing out that the environmental backlash movement has partially moved its protests from the

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general public arena to the classroom. There is a great deal of merit to both of these positions. However, neither mentions the three most important points -- (a) some percentage (not all) of what passed for "environmental education" in its earlier days was derived from one-sided pro-environmental sources, (b) the more recent entry of the backlash group into the educational debate offers a starkly contrasting view, also one-sided, and (c) more importantly, this combination of biases offers a previously unavailable opportunity for students, and teachers, to demand, then compare, clearly stated and effectively justified positions on issues. But teachers and students are obliged to have the background, the intellect, and the will to do so.

2. At the time of the preparation of this manuscript, NAEE/NAAEE's functional leadership was centered in the non-formal sector, primarily in representatives of non-governmental environment-related organizations (NGOs). A decade earlier, representatives of college/ university environmental studies programs were at the helm; they had effectively replaced the community college people who had initiated the association. Since the mid-1970s much of the organization's membership has been made up of elementary and secondary educators -- teachers, administrators, curriculum planners, and teacher educators -- who have shown little interest in organizational politics or direction; as practitioners, they apparently are more interested in sharing ideas and techniques, seeming content to accept the leadership of the other groups as well as the materials and information provided by them.

3. In a brief paper, it is not possible to approach doing justice to the concept of "environmental worldview". Two excellent sources for discussions of environmental worldviews are Norton (1991) and Eckersley (1992). The classical analysis of scientific worldviews, and worldviews in general, was presented by Kuhn (1970).

4. The correspondence between historically defined preservationist perspectives and more modern environmentalist worldviews is imperfect, though for the purposes of this paper it is adequate, because both are philosophically idealized opposites to cornucopianism.

5. In today's world very few individuals completely support extreme cornucopian positions (i.e., rarely does anyone say that environmental quality is of no concern, or that natural resources exist in such quantities that they can be wantonly wasted). By the same token, few preservationists today argue unequivocally against a priority for human needs for resources or dispute the inevitability of problems associated with waste disposal. Rather, it is a matter of degree. The day when anyone wishing to be considered rational will publicly espouse without qualification either extreme view -- unequivocally cornucopian or absolutely preservationist -- is apparently gone, if it ever actually existed. Today, arguments supporting either of the polar positions are typically tempered, if only fleetingly, by stipulating an acknowledged need for vigilance with respect to environmental quality on the one hand, and of human need for resources on the other.

6. Because this paper is written with the formal education system in mind, the discussion is framed in the context of the teacher and the classroom -- the formal education system, generally at K-12 levels. However, the generalizations presented are also appropriate to non-formal and informal educational personnel (interpreters, communicators, etc.) and venues (parks, museums, media, etc.), as well as to post-secondary formal education for both technical and general education.

7. Kuhn's (1970) discussion of what it takes to change societal worldviews (that is, what is involved in cultural paradigm shifts) is both fascinating and instructive. On an individual level, a dramatic change in worldview may be caused by education, propaganda, or a sudden realization of a discrepancy in one's own thinking. But it is also culturally conditioned and highly unpredictable.

8. John Hug's "Two Hats" essay (1975) makes this point as clearly and succinctly as it can be made. Still, Hug's generalization that most teachers are, apparently by nature, environmentalists deserves serious investigation; the reality may be more complicated than that.

_ Ethically and professionally, teachers cannot be propagandists for any worldview, pro-or anti-environmental, pro- or anti-development, nor should they teach their students to be.

9. Indeed, for every issue there is an open question as to how much background information is actually optimal, or even necessary, to achieve an adequate level of understanding, either for educational purposes or for "real world" decision-making purposes. To the extent that educators seek to teach students to engage actively in responsible environmental behavior, it may be argued that those students need to achieve the same levels of understanding of complex environmental phenomena and their implications as do "real world" decision-makers. To some this may seem an academic point best left to the ruminations of educational philosophers, but it is neither moot nor trivial in terms of day-to-day educational practice.

10. The Independent Commission on Environmental Education (1997) found no pattern correlating quality of instructional materials dealing with the environment with the environmental perspectives typically associated with the sponsors.

11. This comment is not intended to imply that there is anything "wrong" with traditional outdoor education, conservation education, and/or nature study.

Each has elements in common with environmental education, and all are typically regarded as its predecessors. In addition, there are valid reasons for including each of them in school curricula. But there are problems in using the term "environmental education" as a synonymous new name for any of them: the first is that none of the three adequately reflects and addresses more modern concerns about environmental issues per se. The second, more insidious, problem is that using the term "environmental education" as a new label for any of them creates confusion in all four fields and in the minds of external observers.

12. This is because environmental issues have more obvious natural/physical science components than do most public issues; because environmental issues are rooted in science and technology they are often considered a part of science, and (in schools) a subset of science education. However, a democratic society ideally addresses and resolves environmental issues, like all public issues, in public forums through political processes with due attention to economic and social ramifications, so there is little logic in pigeonholing environmental education as a subset of any discipline or limited set of disciplines.

From a practical perspective, incorporating environmental education in science education or social studies education can be made to work -- that is, it is possible to squeeze environmental education into content areas that already exist and have established places in educational programs, a la "square peg in round hole". Of course, this strategy is practical -- it does get environmental education in some form into at least some schools. But it creates another dilemma, resulting in tensions for science educators -- viz., is science education being "diluted" (i.e., watered down) by the inclusion of irrelevant material? In this sense, "irrelevant" means not relevant to science education, and does not address the question of the relevance of the social science aspects of environmental education to the total educational program. The concern is valid; science education cannot be expected to expand its curricula to include topics more appropriately addressed by social studies educators, particularly because there is so much science to teach and so many scientific concepts to be mastered. Neither is it reasonable to expect science teachers to demonstrate high levels of instructional competence in dealing with economic-political-social issues. Of course, a parallel argument may be made relative to the inclusion of the natural/physical science aspects of environmental topics in social studies courses -- the social studies curriculum is already overcrowded, disciplinary purity is threatened, and social studies teachers are not academically and/or professionally prepared to deal with the technical aspects of scientific and technological issues.

13. Philosophers, educators, and educational philosophers have grappled with this question for centuries without resolving it. For example, John Goodlad (1979) developed a scholarly (and very readable!) monograph rigorously presenting a broad range of positions on the issue, *What Schools Are For*. Goodlad presents no either-or statement of a "right answer", though he stresses the central necessity of developing mature conceptual understanding and analytical/critical thinking abilities.

14. According to J. Bronowski (1965, p. xiv), "The gravest indictment that can be made of our generalized culture is, in fact, that it erodes our sense of the context in which judgments must be made." This criticism is directly applicable to education in general, as consistently illustrated by the lack of consistently effective approaches to learning about the environment and the range of human interrelationships with it. David Orr (1992, pp. 144-5) makes a similar point in a decidedly different way, by identifying and discussing two challenges to the field of education that arise from environmental perspectives: the challenge of environmental interrelatedness to mono-disciplinary approaches to learning, and the challenge of the necessary re-evaluation of the role of the human in the natural world. In addition to the natural and social sciences, Orr discusses the necessary participation of the humanities in education dealing with the environment.

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Additional Comments

We applaud and agree with this reading when Dr. Disinger writes:

> "There is much room for improvement [in education], because the teacher is ethically obligated as a professional to serve as an effective educator -- a daunting task under any circumstances. In the case of environmental education, this involves facing up to the tensions inherent in the field head-on, in addition to the tensions and pressures created by society's conflicting environmental worldviews, by a poor fit for environmental instruction in the educational system, and by less-than-perfect teaching materials. It may be too much to expect the emergence of ideal environmental education all at once because neither our educational systems nor our socio-political-economic systems are perfect, and also because teachers are as human as anyone else. Still, it is not too much to demand that ideal in the longer run.

Given the overall nature of the educational enterprise and efforts to overcome some of the problems referred to in this reading, we wish to expand on some of these ideas. We certainly do not take exception to what one reads here because, almost in total, we are generally in agreement. On the other hand, we wish to expand on some of those comments, as follows:

1. Dr. Disinger writes:

> From the outset its most obvious [organizational problem has been semantic; those approaching environmental education from its several dramatically different perspectives are likely to say the same words when they mean different things; apparently unknowingly, they have talked past each other since the field was named, and continue to do so. These difficulties with language are actually indicators of striking contrasts in viewpoints, illustrated clearly by very real dissimilarities in two different sets of worldviews -- one concerning the "proper" relationships between humans and the rest of the environment, the other about what education is, is not, should be, and should not be. External pressures, from other educators and from representatives of the full range of environmental perspectives, continue to compound the situation and intensify tensions both within and about the field.

Comment:-
What is interesting is the apparent misunderstanding of many organizational members and administrators, that "education" is the key word, the main noun in NAAEE's name - yes, *education*. It is not the North American Association of Ecologists, Recreationists, Resource Managers, Texas Rangers, Nature Enthusiasts, Bird Watchers, or Hikers or Bikers. We offer the notion that, if all involved did in fact, recognize that "education" was the primary part of the name there would still be problems between factions. However, one might hope that these problems would be lessened. For well over a decade, many thinking professional environmental educators have struggled to establish a thoroughly valid substantive structure for the field of Environmental *Education* - something with scope and sequence with the primary goal in mind of the development of an environmentally-responsible world citizenry. Folks still argue over what the structure should look like and, at the same time, appear to ignore the need for any structure to be intellectually and educationally valid.

2. Dr. Disinger writes: :

> . . . teachers and other communicators . . . are products of and in constant interaction with the cultures in which they were brought up and in which they live. Thus,

> individual teachers are as likely as anyone to espouse one or another of these three worldviews, or of some variant of one or more of them. Also like most other humans, they are not terribly likely to have studied them conscientiously or thought them out rigorously; it is quite possible that they, like other people, have grown up with particular environmental worldviews and accepted them at face value, essentially as truisms. It is, of course, also possible that what they learned during their own formal, non-formal, and informal educational experiences shaded their initial environmental worldviews, or even changed them drastically and dramatically. . . . In any case, their environmental worldviews, lying somewhere along the continuum from cornucopian to preservationist, are typically based on something less than complete information and rigorous critical analysis.

Comment:

As galling as these ideas may be, they are probably true for a large segment of the teaching profession. However, this is a pretty broad brush and may be a bit excessive. First, philosophically, we would be quick to note that a teacher must not - ever - try to bias his/her students as to the "correct solution" to any environmental issue. To do so is totally unethical. However, it is equally important for teachers at all grade levels to learn how to think reflectively about issues and suspend judgment whenever there is not enough evidence to make a definitive decision.

How much information does the teacher - and also the student - need? We simply do not know! But, we do know that neither party will ever have "complete information". This conundrum is terribly frustrating and also ripe with potential outcomes that might not be in the best interests of the environment. Over the many years of our service to education we have heard many, many times that teachers must "cover the topic or the book or the content". This is often the case with content specialists who wish to hover behind the screen of content thoroughness and a concomitant desire not to change - to continue to teach as they were taught. Why is this bad? It is bad because who is to say when "the content is covered"? If young citizens are denied the opportunity to investigate and evaluate issues until they have mastered at least two years of biology, one of earth science, and another of chemistry, albeit any idea of what is "covered" in those courses*, we will be in a pitiful state as a nation. And, if we look back at those that recommend a thorough grounding in subject matter, we find that nowhere do they tell us "how much" is enough.

** - One need only look at the instructional models that are available for use in high school biology to see how variable course content can be. Various schools and various teachers may choose to use an ecological approach - or a phylogenetic approach - or a cellular approach - or a behavioral approach - none of which are especially compatible with the others. The point being simply that it is one thing to talk about "content" and coverage and quite another to talk about appropriateness for particular student populations - especially when only two or three percent of the students will ever become professional scientists but all will become citizens.*

3. Dr. Disinger writes: :

> . . . few educational materials are designed for the purpose of providing a rigorous, objective, balanced examination of all sides of environmental issues; value-neutral educators (if there are any) don't design them, and other producers of materials typically endorse the particular perspective they wish to promulgate by slanting their "educational" presentations accordingly.

Comment:

Certainly, this is an insightful statement - correct and damning as well. We wonder if this condition, perhaps, can be related to our comments in No. 2 above. Regardless, we wish to comment on the term "value neutral". We would posit that educators simply cannot be "value neutral". But, they can and must be "value fair". If teachers are to allow students the opportunity to go out into the community and critically investigate and evaluate issues, then all - or at least many - "sides" will return to the classroom. Only in a value fair situation can these "sides" be discussed openly and reflectively.

And, too, Dr. Disinger is correct in his appraisal of many of the EE materials available today. We must point out, however, that there *are* rigorous, objective, and value fair materials available - and these materials require the learner to consider issue solutions which are ecologically, politically, economically, socially, and legally responsible.

4. Dr. Disinger writes: :

> . . . some aspects of environmental education fit into existing curricula as science, and some as social studies, but the two are not coordinated with one another. Furthermore, the complete environmental education package cannot appropriately be labeled a subheading under either science or social studies, or of any subject area, but the educational system is unable to adjust to that. Further, no one believes that there is room to add a new subject, environmental education, to the curriculum.

Comment:

We are tempted simply to shout a loud "Amen" to this statement but equally tempted to comment, however slightly. We read/infer here that the educational system is unable to adjust to a field that is really interdisciplinary. We agree in part. We also posit, in the strongest possible language, that the educational system ***must adjust*** in some way to this problem. The solution is a muddy one. However, we are seeing movement in some school districts toward cross-disciplinary and interdisciplinary courses, e.g., select schools in Montana, Maryland, and Hawaii. It appears as though team teaching can be viable and successful at both the middle and high school levels. Various school districts accomplish this in a variety of ways - some very successfully!

H. R. Hungerford

"To change human behavior so that it is aligned better with ecological reality will require a major adjustment of the philosophy underlying education in the United States."

Charles Kupchella and Margaret Hyland, 1986

Environmental education enhances critical-thinking, problem-solving, and effective decision-making skills. It also teaches individuals to weigh various sides of an environmental issue to make informed and responsible decisions. Environmental education does not advocate a particular viewpoint or course of action.

(*Federal Register*, Tuesday, December 10, 1996, p. 65106).

The Tbilisi Declaration

Intergovernmental Conference on Environmental Education: October 14-26, 1977

The Tbilisi Declaration is considered to be one of the most important seminal documents in environmental education. Key elements of The Tbilisi Declaration are contained in this reading. Due to space limitations, the original has been abridged. Those wishing to read the entire document are referred to *Connect*, the UNESCO/UNEP Environmental Education Newsletter, Vol. III, No. 1 (January 1978).

The world's first Intergovernmental Conference on Environmental Education, organized by UNESCO in cooperation with the United Nations Environment Programme (UNEP) was convened in Tbilisi, Georgia (USSR) from 14 to 26 October 1977.

Delegates from 66 Member States and observers from two non-Member States participated as well as representatives and observers from eight agencies and programmes of the United Nations system, three other intergovernmental organizations and 20 international nongovernmental organizations. In all 265 delegates and 65 representatives and observers took part in the Tbilisi Conference.

Adopted by acclamation at the close of the Intergovernmental Conference, the Tbilisi Declaration noted the harmony and consensus which had prevailed and the unanimous accord on the important role of environmental education in the preservation and improvement of the world's environment, as well as in the sound and balanced development of the world's communities. The Declaration follows in full.

The Tbilisi Declaration

In the last few decades, man has, through his power to transform his environment, wrought accelerated changes in the balance of nature. The result is frequent exposure of living species to dangers which may prove irreversible.

The Declaration of the United Nations Conference on Human Environment organized in Stockholm in 1972 proclaimed: "to defend and improve the environment for present and future generations has become an imperative goal for mankind." This undertaking urgently calls for new strategies, incorporated into development, which particularly in the developing countries is a prerequisite for any such improvement. Solidarity and equity in the relations between nations should constitute the basis of a new international order, and bring together, as soon as possible, all available resources. Education utilizing the findings of science and technology should play a leading role in creating an awareness and a better understanding of environmental problems. It must foster positive patterns of conduct towards the environment and nations' use of their resources.

Environmental education should be provided for all ages, at all levels and in both formal and nonformal education. The mass media have a great responsibility to make their immense resources available for this educational mission. Environmental specialists, as well as those whose actions and decisions can have a marked effect on the environment, should be provided in the course of their training with the necessary knowledge and skills and be given a full sense of their responsibilities in this respect.

Environmental education, properly understood, should constitute a comprehensive lifelong education, one responsive to changes in a rapidly changing world. It should prepare the individual for life through an understanding of the major problems of the contemporary world, and the provision of skills and attributes needed to play a productive role towards improving life and protecting the environment with due regard given to ethical values. By adopting a holistic approach, rooted in a broad interdisciplinary base, it recreates an overall perspective which acknowledges the fact that natural environment and manmade environment are profoundly interdependent. It helps reveal the enduring continuity which links the acts of today to the consequences for tomorrow. It demonstrates the interdependencies among national communities and the need for solidarity among all mankind.

Environmental education must look outward to the community. It should involve the individual in an active problem-solving process within the context of specific realities, and it should encourage initiative, a sense of responsibility and commitment to build a better tomorrow. By its very nature, environmental education can make a powerful contribution to the renovation of the educational process.

The Role, Objectives and Characteristics of Environmental Education

The Tbilisi Declaration together with two of the recommendations of the Conference constitutes the framework, principles and guidelines for environmental education at all levels - local, national, regional and international - and for all age groups both inside and outside the formal school system.

I. The Conference recommends the adoption of certain criteria which will help to guide efforts to develop environmental education at the national, regional and global levels:

- Whereas it is a fact that biological and physical features constitute the natural basis of the human environment, its ethical, social, cultural and economic dimensions also play their part in determining the lines of approach and the instruments whereby people may understand and make better use of natural resources in satisfying their needs.

- Environmental education is the result of the reorientation and dovetailing of different disciplines and educational experiences which facilitate an integrated perception of the problems of the environment, enabling more rational actions capable of meeting social needs to be taken.

- A basic aim of environmental education is to succeed in making individuals and communities understand the complex nature of the natural and the built environments resulting from the interaction of their biological, physical, social, economic and cultural aspects, and acquire the knowledge, values, attitudes and practical skills to participate in a responsible and effective way in anticipating and solving environmental problems, and in the management of the quality of the environment.

- A further basic aim of environmental education is clearly to show the economic, political and ecological interdependence of the modern world, in which decisions and actions by the different countries can have international repercussions. Environmental education should, in this regard, help to develop a sense of responsibility and solidarity among countries and regions as the foundation for a new international order which will guarantee the conservation and improvement of the environment.

- Special attention should be paid to understanding the complex relations between socio-economic development and the improvement of the environment.

- For this purpose, environmental education should provide the necessary knowledge for interpretation of the complex phenomena that shape the environment, encourage those ethical, economic and esthetic values which, constituting the basis of self-discipline, will further the development of conduct compatible with the preservation and improvement of the environment; it should also provide a wide range of practical skills required in the devising and application of effective solutions to environmental problems.

- To carry out these tasks, environmental education should bring about a closer link between educational processes and real life, building its activities around the environmental problems that are faced by particular communities and focusing analysis on these by means of an interdisciplinary, comprehensive approach which will permit a proper understanding of environmental problems.

- Environmental education should cater to all ages and socio-professional groups in the population. It should be addressed to (a) the general non-specialist public of young people and adults whose daily conduct has a decisive influence on the preservation and improvement of the environment; (b) to particular social groups whose professional activities affect the quality of the environment; and (c) to scientists and technicians whose specialized research and work will lay the foundations of knowledge on which education, training and efficient management of the environment should be based.

- To achieve the effective development of environmental education, full advantage must be taken of all public and private facilities available to society for the education of the population: the formal education system, different forms of nonformal education, and the mass media.

- To make an effective contribution towards improving the environment, educational action must be linked with legislation, policies, measures of control and the decisions that governments may adopt in relation to the human environment.

II. The Conference *endorses* the following goals, objectives and guiding principles for environmental education:

The *goals* of environmental education are:

- to foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural areas;

- to provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment;

- to create new patterns of behavior of individuals, groups and society as a whole towards the environment.

The categories of environmental education *objectives* are:

Awareness: to help social groups and individuals acquire an awareness and sensitivity to the total environment and its allied problems.

Knowledge: to help social groups and individuals gain a variety of experience in, and acquire a basic understanding of, the environment and its associated problems.

Attitudes: to help social groups and individuals acquire a set of values and feelings of concern for the environment and the motivation for actively participating in environmental improvement and protection.

Skills: to help social groups and individuals acquire the skills for identifying and solving environmental problems.

Participation: to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems.

***Guiding principles* - environmental education should:**

- consider the environment in its totality - natural and built, technological and social (economic, political, cultural-historical, moral, esthetic);

- be a continuous lifelong process, beginning at the pre-school level and continuing through all formal and nonformal stages;

- be interdisciplinary in its approach, drawing on the specific content of each discipline in making possible a holistic and balanced perspective;

- examine major environmental issues from local, national, regional and international points of view so that students receive insights into environmental conditions in other geographical areas;

- focus on current and potential environmental situations while taking into account the historical perspective;

- promote the value and necessity of local, national and international cooperation in the prevention and solution of environmental problems;

- explicitly consider environmental aspects in plans for development and growth;

- enable learners to have a role in planning their learning experiences and provide an opportunity for making decisions and accepting their consequences;

- relate environmental sensitivity, knowledge, problem-solving skills and values clarification to every age, but with special emphasis on environmental sensitivity to the learner's own community in early years;

- help learners discover the symptoms and real causes of environmental problems;

- emphasize the complexity of environmental problems and thus the need to develop critical thinking and problem-solving skills;

- utilize diverse learning environments and a broad array of educational approaches to teaching/learning about and from the environment with due stress on practical activities and first-hand experience.

Environmental Education's Definitional Problem

John F. Disinger

This article by Dr. John Disinger is a classic writing in the field. It was prepared as an attempt to examine the various definitions related to environmental education at the time. Although written for publication in 1983, its message continues to hold meaning for environmental education scholars everywhere. It most certainly helps the individual understand something of the roots of environmental education and helps better define what EE is and what it is not. This alone makes it an important contribution to the field. For those interested in the history of EE, this reading will have special import. Thus, "Environmental Education's Definitional Problem" has meaning for a wide audience for any one of a number of reasons. (A 1997 Epilogue follows this article's reference list.)

[ERIC] Editor's Comments

There are those individuals who say that if you can "name" something, you own some knowledge of it. Others consider that knowledge is better displayed if you can provide an operational definition. This issue of the ERIC/SMEAC information bulletin was prepared by Dr. John F. Disinger, Associate Director-Environmental Education in an attempt to examine the various definitions related to environmental education.

A continuing dilemma for those concerned with environmental education lies in the matter of definition. There are some who strive to achieve universal agreement as to a precise meaning and discrete set of descriptive parameters, but others . . . prefer not to expend energy on what they perceive as an inherently non-productive exercise. There also exists a third population, a potpourri of groups and individuals who have independently or semi-autonomously forwarded a variety of definitions and descriptive statements, on occasion demonstrating strong overlap and, on occasion, equally virulent disagreement.

It is at least interesting, and may be productive, to assemble a representative selection of definitions for the purpose of comparing and contrasting them. Attempting to identify commonalities among them, concurrently highlighting disparities and inconsistencies, could as a minimum define the boundaries of the problem, and may provide a platform for achieving its resolution.

Much of this has been done before. Harvey (1976, 1977) reported a rigorous analysis of existing definitions and models as groundwork for the development and presentation of a "delineation of substantive structure" for environmental education; included was a mediating definition. His study has rarely been cited, perhaps because it was not reported in the journal literature and thus for practical purposes may have been unavailable to those who might have found it of use, had they found it at all. Alternatively, it may be that environmental educators of varying plumages were not, and are not, ready for it. General lack of acknowledgment of another study with a related aim but employing a somewhat different approach (Lucas, 1972, 1980, 1980-81) lends credence to either of these possibilities.

This information bulletin re-examines a number of the early definitions and parameter statements reported by Harvey, and includes brief summaries of the outcomes of the Harvey and Lucas studies. Much of the historical material reported is derived from papers by Malcolm Swan (1975), Roderick Nash (1976), John Kirk (1977), and Charles Roth (1978), all cogent reviews of the early history of environmental education and its antecedents. Another key source is Clay Schoenfeld's *Outlines of Environmental Education* (1971 b), a selection of seminal papers from the first two volumes of *The Journal of Environmental Education.* An ERIC search unearthed other definitions and definitional discussions, including but not limited to those too recently advanced to be included in the primary sources. They are also reported in this bulletin in an attempt to develop a current overview of the status of the environmental education definitional problem.

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Origin of the Term

Even the origin of the term ***environmental education*** has been subject to discussion. Harvey (1976) noted a 1968 paper by Schoenfeld as the first use of the term in the scholarly literature, commenting that it was not specifically defined therein. Schoenfeld has disclaimed inventing it, instead (1979) crediting its first use to Brennan, citing the latter's 1964 address to the American Association for the Advancement of Science. C. Roth (1978) also has mentioned Brennan as originator, referencing a 1957 article in the *Bulletin of the Massachusetts Audubon Society*.

However, there is at least one report (Kirk, 1983) of an earlier use: in a 1948 presentation at a Paris meeting of the International Union for the Conservation of Nature and Natural Resources (IUCN) Thomas Pritchard, at that time Deputy Director of The Nature Conservancy in Wales, identified the need for an educational approach to the synthesis of the natural and social sciences, suggesting that it might be called *environmental education*.

Brennan (1979) has acknowledged his early use of the term, but has disavowed any intention of using it other than as a synonym for *conservation education*, in the sense that the latter was used by Brandwein and himself (Proceedings, 1967:17):

> (Conservation education is) the recognition by man of his interdependence with his environment and all of life and his responsibility to maintain the environment in a manner fit for life and fit for living.

Antecedents

It is frequently acknowledged that the primary antecedents of environmental education were *nature study, outdoor education*, and *conservation education*. Nash (1976) summarized:

> The roots of environmental education lie in the same era and mentality as the beginnings of reaction against the university ideal (of compartmentalization of knowledge-Ed.). As early as 1891 Wilbur Jackman's *Nature Study for the Common Schools* launched a nature study movement which took students outdoors to explore an indivisible environment with an integrated academic approach. Outdoor education, as it was called by theorists such as L. B. Sharp and Julian Smith in the 1920s, had a very similar purpose. Nature study and outdoor education forced an appreciation of the multiplicity of factors that the classroom tended to isolate. Knowledge was integrated by an integrated environment.
>
> The 'Dust Bowl' mentality of the 1930s gave rise to conservation education. Its primary object was to awaken Americans to environmental problems and the importance of conserving various natural resources. Because conservation education focused on problems which themselves were products of many interrelated factors, students exposed to such programs pursued a more integrated learning program. Clearly such an approach ran counter to prevailing academic theory... (p.14)

In some discussions other antecedents are nominated; some are noted briefly below. That fact that each antecedent continues to maintain its own proponents, sometimes operating separately from, at other times in conjunction with, one another and/or under the environmental education banner, provides additional evidence of continuing lack of common definition. A quotation from a 1971 Report of the Educational Products Information Exchange summarizes the situation:

> The term environmental education is in itself most loosely defined. At several recent environmental education conferences, the following terms were used synonymously: Environmental Education, Environmental - Ecological Education, Ecological Education, Conservation Education, Camping Education, Outdoor Education, and Environmental Science Education . . . (p.5)

Nature Study

Nature study was not one of the related areas included in the EPIE statement. However, in making a point similar to Nash's, Brice (1972) stated:

> The antecedents of contemporary environmental education can be traced to the nature study movement which developed during the latter part of the nineteenth century and dominated early childhood education until the 1920s. (p.3)

C. Roth (1978) has provided this commentary on the nature study movement:

> Unfortunately many of those who tried to put nature study into practice saw in (Liberty Hyde) Bailey's work only what they wanted to see; they focused on the artsy end of things and mere rambles in the countryside. Respect for the nature study approach dwindled and died in the forties and fifties and the star of rigorous science education began to rise. Bailey is being rediscovered today and people are amazed at the currentness of his thinking; it is almost as if nothing had changed in the 75 years since he wrote it. 'Mere facts are dead,' he wrote, 'but the meaning of facts is life. The getting of information is but the beginning of education. With all the getting, get understanding.'

> In large measure it would appear that the nature study movement was derailed by followers who did not understand adequately its underlying philosophy, but that does not adequately reflect what happened. Implementation of the precepts of Bailey's ideas and those of other key thinkers in the movement would have meant a restructuring of school organization, particularly outside the essentially rural one-room schoolhouse where it originated and flourished. Key to the thinking was Bailey's statement that nature study 'is putting the child into intimate and sympathetic contact with the things of the external world.' (p.14)

Conservation Education

In the early 1900s the focus of the conservation movement in the United States was on the conservation of human resources. This particular aspect has since evolved into present-day health education, and as such does not seem particularly pertinent to the present discussion (Swan, 1975). But by 1935, sufficient emphasis on the natural world had occurred to elicit this statement from the Educational Policies Commission of the National Education Association, as quoted by Funderburk (1948):

> Forests, soils, grasslands, water, minerals, oils, fish, game, and scenic beauty are among the rich natural endowments of the area of the North American continent covered by the United States. Realization of the basic importance of these resources, determination to utilize them for the common good through long range planning, and general knowledge of appropriate remedial and preventive conservation procedures are among the marks of an educated citizen. Since future welfare and safety depend on those things, the schools may well assume considerable responsibility for checking the ravages upon the heritage of the nation made by ignorance, indifference, carelessness, and unbridled selfishness. (pp. 30-31)

This perspective has become and remains the viewpoint of many conservation educators; much of their concern deals with the meanings and application of such terms as "wise use" and "natural resources management." C. Roth has noted (1978):

> The conservation education movement originated in large measure from a governmental base. As environmental problem after environmental problem, from forest depletion to chemical pollution, was met through creation of governmental agencies, from the U.S. Forest Service to the Environmental Protection Agency, certain steps occurred. The first was usually legislation, then enforcement, and then the realization that education was needed so that people would understand and willingly obey the laws. This was not usually 'education' in its broadest, more open, sense, but rather 'advocacy education.' Most of the people assigned to this task were resource, rather than education, oriented. They put out a great deal of printed information and used the public media extensively, but they also wanted to reach out to the great captive audiences in the classrooms. (p.15)

C. Roth and Swan have both noted successful efforts to legislate conservation education into state-level curricula, but question the bottom-line effectiveness of such legislation-i.e., that which is legislated may not be taught. Roth has indicated parallel doubts concerning the effectiveness of the long-standard chapters on conservation included in many elementary and junior high school science textbooks, and some social studies texts.

Outdoor Education

Outdoor education has historically been defined as an educational method or approach -"the use of resources outside the classroom for educational purposes." (Swan, 1975). As such, it has been an important aspect of both nature study and conservation education, but "its direct antecedents as a field of study date back only into the 1920s, and are associated with the conservation of human resources branch of the conservation movement." (Swan, 1975:9) In addition to L. B. Sharp and Julian Smith, mentioned previously, the movement has been closely identified with John Dewey, in that it fits neatly with "learning by doing" philosophies. Sharp is credited with the precise definitional statement - "teach outdoors what is best taught outdoors, and teach indoors what is most appropriate there." According to Swan:

> Perhaps the greatest factor distinguishing outdoor education from the other movements . . . is its application to all components and subjects of the curriculum-art, music, mathematics, science, etc. Although there are many who would give an environmental orientation to everything done in the school, there is that essential difference that outdoor education takes place outside the classroom. The others... can and should take place both in and outside the classroom. (1975:10)

An important aspect of the outdoor education movement has been the school camping movement (C. Roth, 1978); in some ways, school camping *is* outdoor education in the minds of many. Kirk (1977) credits William Gould Vinal as its progenitor. C. Roth comments that school camping had within its successes the seeds of its shortcomings: it is expensive, thus a prime target for cutting in times of budgetary constraint; and it " . . . leads many (school) systems to feel that they have done their duty to environmental education completely if they send their kids off to camp for a week." (1978:16)

Antecedent and Concurrent

Several other educational movements have been identified as forerunners and/or concurrent companions of environmental education.

Resource-use education, a social-studies "twin" of conservation education, focused more heavily on economics and geography than on the natural sciences; according to C. Roth, "the resource-use education people tended to utilize the classroom teacher to a much greater extent in developing instructional materials, (and) their materials were often more pedagogically useful but the content was often much weaker than the conservation education materials." (1978:16)

Progressive education, "the most education-oriented of the forerunners of environmental education," with roots back to Comenius, Rousseau, Pestalozzi, and Froebel, had "its philosophical touchstone in the thought of John Dewey." (C. Roth, 1978:16) The original purpose of this movement related to making education more responsive to the needs of children; among its accomplishments were "some curriculum reforms toward a more holistic approach to learning." The progressive education movement was for a time redirected toward radical social reform, but Dewey's ideas have been reinstituted in part today in the forms of humanistic and experiential education (C. Roth, 1978:16-17).

Resource management education "has represented the professionalization of certain distinct man-land relationships: soil conservation, water management, game management, park management, urban and regional planning, landscape design, architecture, environmental engineering, metropolitan management, and so on" (Schoenfeld, 1971a:4).

Population education became "a part of the environmental quality movement when it was recognized that the issues of population and environmental impact were interwoven and ... that population growth was like a gigantic time bomb" (Swan, 1975:10-11). "The concern for population education was also partly the result of changes in lifestyles that occur naturally as a nation matures and industrializes."

General education has been characterized by Nash (1976:13) as "a deliberate retreat from the tendency of the Germanic university ideal to compartmentalize knowledge, and as such shares with environmental education the basic philosophy of the integration of knowledge." Nash compares them in terms of multidisciplinary approaches, i.e., "rejection of the idea that knowledge is divided into so many pigeon holes and that extending knowledge means reaching back further and further into the holes," (p.14) and problem orientation, which forces cutting across disciplinary lines. According to Nash, environmental education might be viewed as *purposeful* general education.

During the past decade-plus, the above and other themes have behaved as threads intertwining to varying degrees, in multiple patterns, with one another and with the heightened environmental concern which emerged in the late 1960s to produce something, or some things, called ***environmental education*** . A few "newer" elements such as ***energy education*** and ***marine-and-aquatic education*** may be viewed as educational responses to somewhat specific, emerging environment-related concerns, and are perceived by many as subsets of environmental education. Using the same reasoning, it is possible to speak of environmental education as a necessary component of *citizenship education*, and as a primary consideration of *global* education-depending in part, of course, on how they themselves are defined.

Metamorphosis

Bowman (1972), building on earlier work by Hone (1959), has taken the position that environmental education began as an outgrowth of, or metamorphosis from, an increasingly irrelevant conservation education:

> The transition from the conservation to the environmental movement is not clearcut. Conservation education interest began to wane in the late 1950s largely due to demographic changes that had taken place in our country. Conservation education programs which traditionally placed emphasis on renewable resources at the agricultural level had little appeal to a population that consisted predominantly of city dwellers. (p.14)

Kirk (1977) has approached the transition from a different perspective:

> . . . in the late 1960s outdoor educators who had made the shift to attitude formation in conservation were beginning to feel a new set of societal pressures. These same pressures were being applied with equal force on those individuals active in conservation education. The pressures of the late 1960s, which were felt by the leaders in both outdoor education and conservation, were caused by an increased public awareness of the problems of air pollution,

water pollution, noise pollution, landscape pollution, overpopulation, and excess energy demands. It soon became apparent that it was not possible for educators to focus solely on natural resource management and that it was necessary, when speaking about forest lands, woodlands, and open space, to make reference to life in the suburbs and cities. As the environmental problems increased in significance and number, an educational phenomenon began to take place. These external pressures in our society forced the philosophical components of outdoor education and conservation education on a collision course, and in the late 1960s there was a mixing and a blending which resulted in a great explosion or 'quantum jump' which produced a new product, a new philosophy, a new approach: environmental education. (p.34)

By 1969, sufficient interest in environmental education as a "new," discrete entity had emerged to occasion the development of definitional statements. Not all felt, however, that it was necessary to do so:

> . . . to me the terms conservation education and environmental education are and always have been synonymous. The latter term is now in vogue. It's all right with me. I care not one bit what handle we give to the concept. I do care how we go about the job, for environmental education is just as amorphous a term as is conservation education, and is subject to just as many different interpretations (Clark, 1969:8).

It is probable that Clark's position has been and remains the view of many, particularly among practitioners. Nevertheless, definitions began to appear, perhaps because of identified needs such as those expressed by Helgeson, *et al.* (1971):

> The need for a framework for thinking about environmental problems seems clear. With the recent and current interest demonstrated throughout the nation in environmental problems, there is a bandwagon effect which tempts many individuals and groups to declare that their particular interest or program is at the heart of the environmental problem. It is true that everything is related to everything,' and it is also true that one of the great lessons to be learned from environmental problems is that some human actions and decisions have consequences which, although indirect and remote, may be cumulative and disastrous for human welfare. Nevertheless, it is absolutely essential that any problem area that is to be studied seriously, be limited in scope... (p.3)

Early Definitions

In addition to need and/or desire for definition, opportunity also emerged; Harvey (1976) has attributed much of the early proliferation of environmental education definitional statements to the 1969 debut of the quarterly *Environmental Education*, later (1970) renamed *The Journal of Environmental Education*, the first appropriately labeled forum for printed communications in the emerging area. The formation of the National Association for Environmental Education (1971) and the Alliance for Environmental Education (1973) provided additional opportunity.

Though he did not define the term, Schoenfeld as founding editor of the journal described it in the inaugural issue (1969) by reporting contrasting lists of characteristics between "old" and "new," as developed by graduate students in the University of Wisconsin's Conservation Communications Program (Table 1).

An early concise definition, one serving as the basis for many subsequent efforts, emerged from a graduate seminar in the Department of Resource Conservation and Planning of The University of Michigan's School of Natural Resources under the leadership of William Stapp; it also appeared in the first issue of *Environmental Education* (Stapp, et *al.*, 1969):

> Environmental education is aimed at producing a citizenry that is *knowledgeable* concerning the biophysical environment and its associated problems, *aware* of how to help solve these problems, and *motivated* to work toward their solution. (p.54)

Seminar participants further suggested that "the major objectives of environmental education are to help individuals acquire:

1. A clear understanding that man is an inseparable part of a system, consisting of man, culture, and the biophysical environment, and that man has the ability to alter the interrelationships of this system . . .
2. A broad understanding of the biophysical environment, both natural and man-made, and its role in contemporary society . . .
3. A fundamental understanding of the biophysical environmental problems confronting man, how these problems can be solved, and the responsibility of citizens and government to work toward their solution . . .
4. Attitudes of concern for the quality of the biophysical environment which will motivate citizens to participate in biophysical environmental problem-solving. (p.54)

Table 1: Comparison of Characteristics of Earlier and Present Environment Related Education (Schoenfeld, 1969)

Yesterday	Today
Compartmentalized	Comprehensive
Parochial interests	Broader awareness
Local	Global
Rural	Urban
Appended rationales	Indigenous concern
Evangelical	Ecological
Resource-centered	Man-centered
Terrestrial	Universal
Biophysical science	Social studies
Gospel of efficiency	Quest for quality
Technological impetus	Public involvement
Unilateral solutions	Open-ended options
Elementary education	Adult education
Print media	All media
Hunch	Research
Business as usual	Sense of urgency

In defining *environmental management education* as a necessary first step in identifying "fundamental concepts for environmental management education, K-16". Robert Roth (1970a, 1970b) modified the Stapp statement by referencing both biophysical and sociocultural environments and by stressing the management dimension, as follows:

> Environmental management education is the process of developing a citizenry that is:
>
> 1. knowledgeable of the interrelated biophysical and sociocultural environments of which man is a part;
> 2. aware of the associated environmental problems and management alternatives of use in solving these problems; and
> 3. motivated to work toward the maintenance and further development of diverse environments that are optimum for living. (1970b:65)

In 1972, McInnis specified the following as the "fundamental characteristics of effective environmental education;" he later (1975) used them as a platform to develop a discussion of *environmentalized education:*

> 1. That education is most environmental which most facilitates a direct encounter of the learner with the environment being learned.
> 2. Those environments are most educational which maximize the learner's potential capacities to function successfully as an intelligently integrating multi-sensory organism. (According to Mcinnis, "The key word here is 'intelligently,' which feature distinguishes the human organism from others. The use of 'integrating' rather than 'integrated' is also vital, since it indicates an ongoing process.") (p.24)

Evolving Definitions

The above examples were selected for inclusion here as representative of the types of definitional statements appearing in the early literature; by no means do they constitute the complete set. The elements of definitions in current general use, along with those concerns which continue to make it difficult to arrive at definitional consensus, may be found within them. An added complication is that definitions of antecedents are still on occasion advanced as definitions of environmental education.

Few "new" definitions have appeared beyond those reported, but there have been a number of modifications, extensions, and re-considerations; some are treated below.

Brennan and Schoenfeld

Brennan (1970) furnished the following definition of environmental education, based upon earlier definitional discussions of conservation education supplied by Brandwein and himself:

> (Environmental education is) that education which develops in man a recognition of his

> interdependence with all of life and a recognition of his responsibility to maintain the environment in a manner fit for life and fit for living-an environment of beauty and bounty, in which man lives in harmony. The first part of environmental education involves development of understanding; the second, development of attitudes - a 'conservation ethic.' (p.2)

In 1973, Brennan re-stated his preference for the term conservative education, but acknowledged environmental education definitions which identified the same goals as those he associated with conservation education. In 1979, he questioned the effectiveness of environmental education as it had been practiced since its inception, stating that:

> There was never any intent to eliminate conservation from our purview, for conservation was, and is, our only reason for being in this business of environmental education. Yet that has been done; conservation has been eliminated. (p.46)

Schoenfeld expressed similar concerns in a 1975 editorial, particularly with respect to the ways environmental education was being approached by the U. S. Office of Education. In 1980, he called for the initiation of *integrated environmental management education* as the proper touchstone for environmental education.

The Stapp Definition

The "Stapp definition" has been a basis for continuing discussion and expansion, by Stapp and others. His three-pronged statement of objectives - knowledge of environmental problems, awareness of possible solutions, and motivation to work toward solutions - has become to many an article of faith. However, Stapp (1970) has cautioned that educational research does not support the optimistic assumption that acquisition of information and skills will lead to positive changes in social behavior.

Because Stapp has exerted influence at an international level, further discussion of the "Stapp definition" is continued below under the *International/Global* heading.

The Roth Definition

Another analysis of R. Roth's concept list (Bowman, 1972), using a Q-sort technique, identified four major areas of concern: *biophysical* (living things are interdependent with one another and the environment); *sociocultural* (the relationships between man and the environment are mediated by culture); *environmental management* (the management of resources to meet the needs of successive generations demands long range planning); and *change* (organisms and environment are in constant change).

Bowman's model identified interrelationships between and among these areas, also specifying their interrelationships with the knowledge ("neutral") and values ("individual") dimensions of environmental education, reinforcing the overall "quality of life" objective stressed by Roth. In 1973, Roth provided a modification of the Bowman model which dealt with both formal and non-formal approaches to environmental education and communication.

Environmental Literacy

The necessity of *environmental literacy* was clearly described by President Nixon in his August 1970 Environmental Message to Congress:

> It is also vital that our entire society develop a new understanding and a new awareness of man's relation to his environment-what might be called 'environmental literacy.' This will require the development and teaching of environmental concepts at every point in the educational process. (p.11)

A number of applications of the environmental literacy concept have appeared since 1970, among them a statement of *The Fundamentals of Environmental Education* by the Subcommittee on Environmental Education of the U.S. Federal Interagency Committee on Education (1976), which included as its main topics "Fundamentals about Earth's Environment," "Fundamentals concerning Humans as Ecosystem Components," "Methods for Harmonizing Human Activities with Ecosystem Processes to Achieve Environmental Quality," and "Using Fundamentals of the Environment and Understanding the Methods."

U.S. Office of Education

Particularly targeted by the 1975 comments of Schoenfeld and the 1979 criticisms by Brennan were the applications of the Environmental Quality Education Act, commonly called the Environmental Education Act (U.S. Public Law 91-516,1970), which Brennan said rejected funding proposals related to nature study, conservation, and outdoor education, and Schoenfeld noted did not support efforts of historically successful agencies and organizations. The Act offered this definition:

> For the purposes of this Act, the term 'environmental education' means the educational process dealing with man's relationship with his natural and manmade surroundings, and includes the relation of population, conservation, transportation, technology, and urban and

regional planning to the total human environment. (p.1)

As part of its preparation for implementation of the Act, the U.S. Office of Education (1970) published the following:

> Environmental education is a study of the factors influencing ecosystems, mental and physical growth, living and working conditions, decaying cities, and population pressures. Environmental education is intended to promote among citizens the awareness and understanding of the environment, our relationship to it, and the concern and responsible action necessary to assure our survival and to improve the quality of life . . .
>
> It is important to understand that environmental education is much more than a schoolhouse approach to ending the degradation of man's surroundings and the pollution and destruction of the natural world. Environmental education will not simply provide the nation with skills to meet or solve those problems. It is not merely a course in school or a curriculum combining elements of the natural and physical sciences into a new department of specialty. Nor is it just another name for outdoor education, resource management, or conservation education.
>
> Environmental education provides alternate ways of thinking - a synthesis - which colors and affects the humanities, languages, social sciences, history, economics, and religion as dramatically as it does the natural sciences. It will give an ecological perspective for every aspect of learning. (pp. 10-11)

In 1973 Walter Bogan, at the time director of the U. S. Office of Education's Office of Environmental Education, commented: "A completely acceptable definition of environmental education has not yet been found, for environmental education is a relatively new activity still undergoing important developments in its practical application and theoretical foundation." (p.1) He proposed two working definitions:

1. (emphasizing process and theory): . . . the process of environmental education helps the learner perceive and understand environmental principles and problems, and enables him to identify and evaluate the possible alternative solutions to these problems and assess their benefits and risks. It involves the development of skills and insights needed to understand the structure, requirements, and impact of interactions within and among various environmental amenities, subsystems, and systems.
2. (emphasizing content and purposes): . . . environmental education is the process of inquiry into both the specific and general environmental implications of human activities viewed from the perspective of social needs and values as they relate to general public policy. (pp. 1-2)

In a similar vein, Tanner (1974) commented:

> Ultimately, we believe, environmental education must focus on the Spaceship Earth concept. It must deal with man-man or man-society relationships only as they affect, or are affected by, man-earth relationships. Other endeavors, worthwhile though they may be, are not environmental education. To be useful, a concept must be both inclusive *and* exclusive. (p.84)

International/Global

Recommendation 96 of the 1972 Stockholm Conference on the Human Environment called for the development of environmental education as one of the most critical elements of an all-out attack on the world's environmental crisis. A need identified at that conference (United Nations, 1972) was:

> Creating citizenries not merely aware of the crisis of overpopulation, mismanagement of natural resources, pollution, and degradation of the quality of human life, but also able to focus intelligently on the means of coping with them. (p.7)

A report (Barry, 1976) in the first issue of the Unesco-UNEP environmental education newsletter *Connect* reported this goal statement from the October 1975 International Environmental Education Workshop at Belgrade, Yugoslavia:

> The goal of environmental education is to develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations, and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones. (p.2)

The same article listed the following as objectives for environmental education: awareness, knowledge, attitude, skills, evaluation ability, and participation.

In 1979, Stapp, *et al.*, emphasized that "the evolving goal of environmental education is to foster an environmentally literate global citizenry that will work together in building an acceptable quality of life for all people." (p.92) They further stated that the basic aim of environmental education as defined by the participants of the 1977 Unesco-UNEP Intergovernmental Conference on Environmental Education (held in Tbilisi, Georgia, USSR) is: . . . to succeed in making individuals and communities understand the complex nature of the natural and built environments resulting from the interaction of their physical, biological, social, economic, and cultural aspects, and acquire the knowledge, values, attitudes, and practical skills to participate in a responsible and effective way in anticipating and solving environmental problems, and in the management of the quality of the environment. (p.92)

Cowan and Stapp (1982) have further explored this theme, documenting it with a set of case studies collected from around the world.

Research Studies

With the primary exceptions of those definitions generated by Robert Roth and his students, the preponderance of the definitions cited above fit into the categories of philosophical statements and/or arguments for previously-held positions. However, three additional doctoral-level research studies reported during the 1970s focused specifically on defining environmental education in terms of goals, perspectives, and structure.

Relationships between and among the goals of *environmental education, ecological education, outdoor education, conservation education, environmentalized education,* and *general education* were evaluated in a 1977 study by Johnson. Using goal statements from the literature of each field and a Q-sort procedure, 65 selected individuals representing the six areas rank-ordered the statements. Goals describing man's relationship to and utilization of the environment were ranked high by all groups; environmental educators, environmentalized educators, and conservation educators ranked many of the same goals highest. A model developed to illustrate the relationships among the six groups showed environmental education overlapping the five other areas, with especially strong overlaps with conservation education and environmentalized education. The study also illustrated the uniqueness of ecological education, general education, and outdoor education.

A perceptive analysis of environmental education in terms of perspectives has been reported by Lucas (1972,1980, 1980-81). Based on a detailed analysis of the early literature of environmental education and enhanced by rigorous application of the principles of logic, he argued that:

> . . . uses of the term environmental education can be classified into education *about* the environment, education *for* (the preservation of) the environment, education *in* the environment, and the classes formed by the combinations *about* and *for*, *about* and *in*, and *about*, *for*, and *in*. Education *about* the environment, which is concerned with providing cognitive understanding including the development of skills necessary to obtain this understanding, and education *for* the environment, which is directed environmental preservation or preservation for particular purposes, are characterized by their aims; education *in* the environment . . . is characterized by a technique of instruction. In the *in* case, environment usually means the world outside the classroom, and in the other usages it usually refers to the biophysical and/or social context in which groups of people . . . exist . . .
>
> The Belgrade Charter adopted . . . in 1975 includes a statement of the goal of environmental education which is very clearly *for* the environment. (1980-81:33-34)

Harvey's study (1976,1977) attempted to determine if a generally accepted definition and a generally accepted model or delineation of substantive structure existed. His thorough review of the literature, including most though not all of the sources cited above through 1976 and also including a number of definitions and models not cited here, demonstrated that none existed, so he undertook their development. Through use of key word and key phrase analysis of existing definitions, the following "mediating definition" was constructed:

> (Environmental education is) an interdisciplinary, integrated process concerned with resolution of values conflicts related to the man-environment relationship, through development of a citizenry with awareness and understanding of the environment, both natural and man-altered. Further, this citizenry will be able and willing to apply enquiry skills, and implement decision-making, problem-solving, and action strategies toward achieving/ maintaining homeostasis between quality of life and quality of environment. (1976:158)

A similar procedure was used to construct a generic substantive structure, employing three basic components - philosophy, precept, and expected outcome - to subsume those elements identified by 49 models purporting to describe environmental education and/or its facets. The first component, philosophy, was perceived to be "Spaceship Earth," with a "lifeboat concept" frame of reference. As detailed by Harvey, "Spaceship Earth" includes man, environment, and relationship as major components, while the "lifeboat concept" provides a values/ethical orientation.

The second component of Harvey's structure, its precept, is conceptualized as the people-environment relationship (PER), operating in a values-laden context. PER is defined as:

> . . . the consideration of, planning for, and implementation of natural resource use by human beings; the resultant products and processes; and implications for impact on the environment reflected in each person's perception of an acceptable quality of life. (1977:67)

Harvey identified as the expected outcome of environmental education "environmental literacy," which he defined at three levels-environmentally literate, environmentally competent, and environmentally dedicated. These levels may be interpreted as being comparable to Stapp's 1969 three-part statement of objectives.

As an interesting outcome of his study, Harvey concluded that the term *environmental education* is a misnomer, based on his observation that the terminologies most often appearing in the professional literature would lead to *person-environment relationship education* (PERE), defined thusly, as the appropriate term:

> (PERE is) the process of developing an environmentally literate, competent, and dedicated citizenry which actively strives to resolve values conflicts in the person-environment relationship, in a manner which is ecologically and humanistically sound, in order to reach the superordinate goal of a homeostasis between quality of life and quality of environment. (1977:68)

He further noted that much of the environmental education literature is not about the person-environment relationship as defined, but about "person-environment relationship foundations" (PERF), which are:

> . . . topics which provide learnings (psychomotor, cognitive, or affective) about the people-environment relationship, in a non-values laden context, which are prerequisite, or complementary, to PERE. (1977:70)

In expansion of his definition of PERF, Harvey indicated that "People-focused foundations are topics which have as a main focus the human being, either individually or collectively," "Environment-focused foundations are topics which have as a main focus the biophysical environment and its systems," and "Relationship-focused foundations are topics which have as their main focus the relationship between human beings and the earth, as well as the products/ processes resultant from that interaction . . . in a non-values-laden context." (1977:70)

Summary

That unanimity of agreement concerning *the* definition of environmental education has not been reached was clearly demonstrated by an editorial footnote in a recent issue of *The Journal of Environmental Education* (Editor, 1982), which said:

> This editorial seemed to succeed quite well in suggesting real parameters for a well-known type of educational endeavor. Environmental education is now well over a decade old. Can we define it as well? Do we need to? (p.3)

Hungerford, et al (1983), said in response, referencing their work and Harvey's:

> It is disconcerting (to say the least) for those involved in the implementation of environmental education goals to hear again the question: 'What is environmental education?'. . . We submit that environmental education does have a substantive structure that has evolved through the considerable efforts of many and that the framework has been documented formally in the literature. The question asked . . . has most certainly been answered. One would dare hope that this question could, at long last, be laid to rest . . . the field is quite definitely beyond the goal setting stage and into the business of implementation. (p.2)

. . . environmental education does have a substantive structure that has evolved through the considerable efforts of many and that the framework has been documented formally in the literature.

It appears that Harvey's mediating definition and structural model have in fact subsumed the substance of earlier definitions and models; it also appears that no definitions or models proposed since the completion of his work in 1976 are at variance. The same might also be said with respect to Lucas' "in, about, and for" analysis, and to Johnson's definitional study. But these works do clearly lie "mostly unattended by professionals" (Hungerford, *et al.*, 1983:2).

Two possible reasons for this situation were suggested in the early paragraphs of this paper. A third possibility is a manifestation of what Schafer (1979) has called "the dung heap syndrome" - territoriality, or turf protection. Any of them may be *the* reason; it is more likely that they are three contributing reasons.

In any case, the basic problem appears to be one of communications - either those concerned are not aware of what each other are saying, or they choose not to acknowledge, discuss, or debate it, for whatever reasons. A number of apparently viable definitions and models have been advanced; Harvey has provided an analysis of most of them, and proposed a middle ground. Thus, it would appear that the groundwork has been laid for dialogue, early agreement, and "getting on with it."

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An Epilogue

EE's Definitional Problem: 1997 Update

John F. Disinger

One way of defining environmental education is to describe its dimensions. North American Association for Environmental Education (NAAEE) Executive Director Ed McCrea took this tack in 1993 when he informally proposed five "clusters of values" as environmental education's proper foci. McCrea's proposal was re-phrased and published, though without attribution, in the 1996 Report of the National Environmental Education Advisory Council -- protecting human health, advancing quality education, expanding employment opportunities, promoting sustainable development, and protecting America's natural heritage. This set has several advantages, primary among which is the placement of wide boundaries on its scope while at the same time bringing environmental education closer to mainstream educational concerns. It also neatly straddles the preservation-utilitarian dichotomy while emphasizing the health-related concerns associated with today's emphases on quality of human life. According to McCrea,

> Together, these clusters.... reflect the values espoused by American society in terms of concern for and attention to quality of the natural environment, to human health as related to the environment, to human welfare in relation to environmental jobs and careers, to global concerns such as overpopulation and poverty, and to educational quality as it may be enhanced through environmental education.

Essential Characteristics

In its 1996 publication *Environmental Education Materials: Guidelines for Excellence*, NAAEE's Guidelines Writing Team described six essential characteristics of instructional materials for the field: fairness and accuracy in presentation of diverse perspectives, conceptual depth as appropriate to different developmental levels, lifelong skill building in terms of those necessary for addressing environmental issues, action orientation -- promoting civic responsibility by encouraging application of knowledge, personal skills, and informed assessments of environmental issues, instructional soundness of teaching techniques, and usable, well-designed materials. These characteristics are consistent with long-standing definitions of environmental education's content and process, but within them are the disparate ingredients of environmental education's continuing definitional dilemma.

Definitional Progress?

At best, environmental education's definitional problem has moved only minimally closer to resolution during the 14 years between the 1983publication of the earlier definitions paper and the preparation of this 1997 postscript, because -- as illustrated by the "essential characteristics" described above -- the reasons the problem existed in the first place persist. This should be no surprise: though environmental education is ideally interdisciplinary -- an eclectic assemblage of interacting disciplines -- its practitioners typically approach it as if it were multidisciplinary -- an eclectic assemblage of discrete disciplines. Because environmental education's practitioners typically are grounded in no more than one of the multiplicity of disciplines involved, logic leads them to approach environmental education through the intellectual filters of their own disciplines. Thus, practitioners in environmental education typically continue to talk past one another, rather than with one another; all say things approximating "the right thing," but they apparently do not recognize the generally subtle, sometimes glaring, differences in meaning between their utterances and those of their colleagues. The same is true at times of environmental education's theorists, though on occasion they seem to be engaged in semantically charged discussions involving misinterpretations of one another's positions.

On an abstract level, recognizable definitional progress has been made during the 1990s. For example, U.S. EPA's Office of Environmental Education published the following in 1992:

> Environmental education is a process that leads to responsible individual and group actions .... Environmental education should enhance critical thinking, problem solving, and effective decision-making skills .... Environmental education should engage and motivate individuals as well as enable them to weigh various sides of an environmental issue to make informed and responsible decisions. (EPA Environmental Education Grants Solicitation Notice, *Federal Register*, Friday, October 16, 1992, p. 47516)

In 1996, the same office refined the above definition as follows:

> Environmental education enhances critical-thinking, problem-solving, and effective decision-making skills. It also teaches individuals to weigh various sides of an environmental issue to make informed and responsible decisions. Environmental education does not advocate a particular viewpoint or course of action. (*Federal Register*, Tuesday, December 10, 1996, p. 65106).

Also in 1996, the National Environmental Education Advisory Council -- advisory to U.S. EPA's Environmental Education Division -- went on record with the following:

> (Environmental education is) a learning process that increases people's knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address these challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action.

Clearly, the operative terminology in all of these definitions calls for the development of specific, but elusive, skills -- critical thinking, problem solving, and effective decision-making. Certain words appear frequently -- "informed," "responsible." All of these definitions also mention "action," but the 1996 Federal Register definition explicitly calls for objectivity and non-advocacy. The other definitions noted above implicitly endorse the same characteristics.

The Dilemma, in 1997

These definitions characterize current thrusts within the field, and also offer a basis for understanding differences of opinion as to what environmental education should be in practice. An Independent Commission on Environmental Education (ICEE), organized as a project of the George C. Marshall Institute, has strongly recommended (1997) that environmental educators focus their efforts on the acquisition of knowledge, eschewing the notion that teaching be directed toward promotion of changes in behavior.

. . . development of responsible environmental behavior is contingent on the development of critical thinking and citizenship skills, not unthinking stimulus/response mechanisms.

Environmental educators Robottom and Hart (1995) have argued that the tendency of environmental educators to emphasize behavioral modification contradicts one of education's primary aims -- the development of independent critical thinking. But many environmental educators believe that the field's overall purpose must be to foster responsible environmental behavior (Hungerford and Volk 1990), so on the surface there appears to be a dramatic difference of opinion. The central question now becomes, can fostering a particular brand of behavior promote the development of critical independent thinking?

But the real question may be: "To what extent is this difference real, and to what extent imagined?" The ICEE Report acknowledges the importance of development of citizenship skills, and the Hungerford-Volk prescription for development of responsible environmental behavior is contingent on the development of critical thinking and citizenship skills, not unthinking stimulus/ response mechanisms. So what is the difference, or what are the differences? At the theoretical level, they appear to be largely in wording -- everyone professes commitment to the concept of critical thinking, and all eschew propagandizing. Perhaps an astute semanticist might be engaged to sort out the actual differences in meaning.

But on an operational level, the differences may be significant. Currently environmental educators are being charged -- "broadsided" might be a more accurate description -- with promoting environmental advocacy rather than educating, attempting to turn schoolchildren into rabid environmentalists, blindly following instruction to take direct action on complex issues that they do not understand (Sanera and Shaw, 1996). Though the evidence presented is anecdotal at best, such evidence does exist -- at least occasionally, environmental education in the classroom takes the form of preaching rather than teaching, propagandizing rather than educating. To the extent that this actually is the case -- and no one has documented what that extent is -- those professing to be environmental educators are professionally obligated to rethink their goals, objectives, procedures, and teaching techniques, along with their definitions.

. . . those professing to be environmental educators are professionally obligated to rethink their goals, objectives, procedures, and teaching techniques, along with their definitions.

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This epilogue was prepared by Dr. Disinger at the request of this book's editors.

"[Environmental educators] have little or no agreement as to what environmental education is, or when or how one does it.

. . . For decades now, full-time practitioners of environmental education continually invent and re-invent the EE curriculum , with every nature center or park staff or university placing its own personal spin on what environmental education should look like. Worse, I've seen practitioners with no work experience step into jobs writing EE curriculum. Excuse me?

Environmental education is a 'paradigms lost.' . . . . we are mad scientists, cobbling together our own individualized environmental education Frankenstein, stitching together curricular body parts stolen from workshops and workbooks . . . . A complete environmental education curriculum is born. Or so we think. . . . . there is no penalty paid by that school that refuses to create a rigorous EE curriculum."

Mike Weilbacher, in *Clearing: Environmental Education in the Pacific Northwest*, a bi-monthly journal published by Creative Educational Networks, PO Box 5176, Oregon City OR 97045, (Issue 96 - January/February 1997).

The Concept of Environmental Education

William B. Stapp, et al.

No book of readings would be complete without this article as a component part. It is an environmental education classic.

In this article, Dr. Stapp and his associates develop a considered definition of environmental education - a definition which is very consistent with many of those one finds in the literature today. Given that this article was published in 1969, one wonders why in the world other scholars debated so vociferously about a definition for environmental education. Even other excellent definitions which do the field justice, e.g., the EPA definition found elsewhere in this book, do little more than take the reader further into the substantive structure of the field. In this dimension at the very least, Dr. Stapp was far ahead of his time.

WITHIN THE past 50 years, the United States has become a predominately urban nation, both in thought and in physical character. Large and middle-sized communities, many within complex urban regions, have evolved to where over 70 percent of this country's population resides on one and one-half percent of the nation's land surface. By 1980, eight out of ten Americans will probably live in an urban environment. Consequently, the independent rural-oriented living that once characterized this country's social and political heritage is no longer a dominating influence in the lives of most Americans.

In rural surroundings, direct daily contact with the basic natural resources was prevalent, especially within man's immediate environment. As man became progressively urbanized, his intimate association and interaction with natural resources diminished and, with it his awareness of his dependency on them. Yet, it is imperative that man, wherever he lives, comprehend that his welfare is dependent upon the proper management and use of these resources.

Man should also have an awareness and understanding of his community and its associated problems. Our communities are being plagued with problems such as: lack of comprehensive environmental planning; indiscriminate use of pesticides; community blight; air and water pollution; traffic congestion; and the lack of institutional arrangements needed to cope effectively with environmental problems. While these problems are legitimate concerns of community governmental officials and planners, the responsibility for their solution rests, to a large extent, with citizens.

To an increasing extent citizens are being asked to make decisions that affect (directly and indirectly) their environment. Specifically, citizens make these decisions as they cast votes on community issues; as they elect representatives to policy-making bodies; as they directly act upon the environment itself. Citizens can be effective in influencing sound policy in other ways. They can ask informed questions, at the proper time, of the right people. They can serve on advisory and policy-making committees. They can support sound legislation directed at resolving environmental problems. To perform these tasks effectively, it is vital that the citizenry be knowledgeable concerning their biophysical environment and associated problems, aware of how they can help solve these problems, and motivated to work toward effective solutions.

The definition and major objectives of environmental education presented in this paper were developed in a graduate seminar in the Department of Resource Planning and Conservation, School of Natural Resources, The University of Michigan. The members of the seminar were: Mr. Dean Bennett, Mr. William Bryan Jr., Mr. Jerome Fulton, Miss Jean MacGregor, Mr. Paul Nowak, Mr. James Swan, Mr. Robert Wall, and Professors Spenser Havlick and William B. Stapp.

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Most current programs in conservation education are oriented primarily to basic resources; they do not focus on community environment and its associated problems. Furthermore, few programs emphasize the role of the citizen in working, both individually and collectively, toward the solution of problems that affect our well being. There is a vital need for an educational approach that effectively educates man regarding his relationship to the total environment.

The Supreme Court decision regarding the one-man, one-vote concept, enabling the increasing urban majority to acquire greater powers in decision-making, makes it imperative that programs developed for urbanites be designed with them in mind. It is important to assist each individual, whether urbanite or ruralite, to obtain a fuller understanding of the environment, problems that confront it, the interrelationship between the community and surrounding land, and opportunities for the individual to be effective in working toward the solution of environmental problems.

This new approach, designed to reach citizens of all ages, is called "environmental education." We define it in this way:

Environmental education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution.

Environmental education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution.

The major objectives of environmental education are to help individuals acquire:

1. A clear understanding that man is an inseparable part of a system, consisting of man, culture, and the biophysical environment, and that man has the ability to alter the interrelationships of this system.

The principal feature of the philosophy of environmental education is that man is an integral part of a system from which he cannot be separated. Specifically this system consists of three components, man, culture, and the biophysical environment. Culture, in this context, incorporates organizational strategies, technological processes, and social arrangements (political, legal, managerial, educational, etc.) through which man interacts with the biophysical environment. The biophysical environment designates both the natural and man-made components of the environment.

The fundamental relationship between the integral parts of the system is man's interaction through culture on the biophysical environment to produce or obtain the goods and services that he needs.

Within the system, man has the ability either to strengthen, weaken, or maintain the interrelationships between the system's major components. The ultimate goal of environmental education is the development and maintenance of a high quality system in which man interacts through culture on the biophysical environment to advance human welfare.

2. A broad understanding of the biophysical environment, both natural and man-made, and its role in contemporary society.

The existence of any civilization is dependent upon man's use of natural resources. Resources are defined as those parts of the biophysical environment which are appraised by man as being immediately or potentially useful to him.

A basic understanding of natural resources ideally includes their characteristics, distribution, status, interrelationships, and their present and potential uses. Natural resources serve man in many ways, whether in a relatively undisturbed condition or in the highly altered utilitarian forms of the man-made biophysical environment. A strong understanding of how these resources are used requires knowledge of the social, political, economic, technological processes, institutional arrangements, and aesthetic considerations which govern their utilization.

The man-made components of the biophysical environment result from man's use of natural resources. An understanding of this aspect is also essential: it should ideally include familiarity with urban and rural design, including transportation systems, spatial patterns of development, and aesthetic qualities which have a major impact on the functioning of society. Fundamental to these understandings should be the realization that the development of the man-made environment should strive for a high quality system which improves human welfare in relation to the natural environment.

3. A fundamental understanding of the biophysical environmental problems confronting man, how these problems can be solved, and the responsibility of citizens and government to work toward their solution.

Biophysical environmental problems result from the interactions between man, culture, and the biophysical environment. Pollution, the inefficient utilization and management of natural resources, the indiscriminate use of pesticides, urban blight, and transportation congestion are just a few biophysical environmental problems. These problems, caused by a complex set of biological, physical, and social factors, affect the total environmental system.

Citizens need to understand how to work toward solutions of biophysical environmental problems through laws, public policies, planning, resource management, research, technological developments, and institutional arrangements.

Citizens should realize that the responsibility for solutions to these problems belongs to them and the governments which represent them.

4. Attitudes of concern for the quality of the biophysical environment which will motivate citizens to participate in biophysical environmental problem-solving.

The word "attitude" used in this context implies more than simply the knowledge of a body of factual information. Instead, it implies a combination of factual knowledge and motivating emotional concern which result in a tendency to act. Further, it is understood that clusters of attitudes about similar environmental conditions will motivate individuals to express their attitudes. Therefore, for environmental education to achieve its greatest impact, it must: 1) provide factual information which will lead to understanding of the total biophysical environment; 2) develop a concern for environmental quality which will motivate citizens to work toward solutions to biophysical environmental problems; and 3) inform citizens as to how they can play an effective role in achieving the goals derived from their attitudes.

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Epilogue for:
"The Concept of Environmental Education"

As the first International Director of Environmental Education for the United Nations Educational, Scientific, and Cultural Organization (UNESCO), Dr. Stapp had the unique opportunity to work in close association with environmental educators on all continents in preparation for the Belgrade Working Conference on Environmental Education (1975) and the Tbilisi Intergovernmental Conference on Environmental Education (1977).

Two international environmental education definitions adopted by the world community six years following "The Concept of Environmental Education," published in the first *Journal of Environmental Education*, are as follows:

Working Definition of Environmental Education -- Belgrade (1975):

Environmental education should be an integral part of the educational process, aimed at practical problems of an interdisciplinary character, build a sense of values, and contribute to public well-being. Its focus should reside mainly in the initiative of the learners and their involvement in action and guided by both the immediate and future subjects of concern.

Concept of Environmental Education -- Tbilisi (1977):

Environmental education is a process aimed at developing a world population that is aware of and concerned about the total environment and its associated problems, and has the attitudes, motivations, knowledge, commitment and skills to work individually and collectively towards solutions of current problems and the prevention of new ones.

Awareness -- to help individuals and social groups acquire an awareness of and sensitivity to the total environment and its allied problems;

Knowledge -- to help individuals and social groups gain a variety of experiences with the total environment and to acquire a basic understanding of the environment, its associated problems and humanity's critical responsible presence and role in it;

Attitudes -- to help individuals and social groups acquire social values, strong feelings of concern for the environment and the motivation for actively participating in its protection and improvement;

Skills -- to help individuals and social groups acquire the skills for working toward the solution of environmental problems and to foster a dialogue between these groups; and,

Participation -- to help individuals and social groups develop a sense of responsibility and urgency regarding environmental problems to ensure appropriate action to help solve these problems and avoid future problems.

Bill Stapp
September 1997

The Status of Environmental Education with Respect to the Goal of Responsible Citizenship Behavior

Gerald R. Culen

In this original article, Dr. Culen elaborates on the goals of environmental education with special attention given to issue instruction and the ultimate goal of EE instruction, i.e., promoting responsible environmental behavior. The variables associated with environmental behavior are also examined along with the instructional applications/methodologies used to develop in learners the skills needed for responsible environmental behavior. This reading and the associated synthesis provides research support for the continued development of curricula which encourage responsible environmental behavior.

The Goal of Environmental Education

The primary goals of EE are to develop environmentally literate citizens and to promote responsible environmental behavior. Considering that the primary goals of education are to foster societal values and promote certain desirable behaviors, the goals of EE could be viewed as being very consistent with general education goals. Although this parallel exists, EE is still far from the mainstream of our educational systems. In numerous states and countries EE is a step-child of education, receiving only sporadic attention. EE lacks commitment that involves students throughout their schooling in research based scope and sequence programs. "As a result, only a fraction of our young learners are being exposed to logically developed, well articulated EE programs" (Hungerford & Volk, 1990, p.16).

The goal of developing and promoting responsible environmental behavior is widely accepted among environmental educators. Among some of the earlier writers Lamb (1975) states the consensus of Hardin, Kormondy, Kolb, Stotler, and others calling for the development of an environmental ethic or literacy which will insure that students use knowledge and skills for resolving environmental problems. Additional writers, Childress and Wert, (1976); Harvey, (1977); Hungerford and Peyton, (1976); Hungerford, Peyton, and Wilke, (1980); Rubba and Wiesenmayer, (1985); Stapp, (1978); have taken similar positions that environmental behavior is the ultimate goal of EE.

While many environmental educators agree upon the importance of environmental behavior, until recently only a few have incorporated behavior-related instruction into curriculum development projects. Recent studies (Andrews, 1992; Pomerantz, 1991) find that most instructional strategies and techniques are based on environmental awareness models with emphasis on ecological foundations and appreciation of environmental resources.

While there is some agreement among researchers that knowledge of and attitudes toward the environment influence environmental behavior, little is known about the exact relationships between these variables. Winston (1974) explains that attitudes toward the environment influence environmental behavior, but little is known about the nature or formation of these attitudes. Apparently, most of the existing environmental education programs have based their efforts upon the information presently available regarding knowledge and attitudes:

> Educational efforts to produce environmentally literate citizens have been largely based on the postulate that a linear relationship exists among cognitive (knowledge), affective (attitudes), and connotative (behavioral) domains. Accordingly, environmental education programs often present awareness and knowledge of ecology and/or environmental issues, and assume that this will lead to the desired attitude development and ultimately to the necessary environmentally ethical behaviors. (Peyton & Miller, 1980, p.2)

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Numerous EE programs based on a linear model of knowledge - attitudes - behavior have been developed and functioning since the 1960's. If this model was valid, it would be logical to assume that environmental problems would be on the decline due to pro-environmental behavior from within the population. This does not appear to be the case. One only has to review the annual reports by organizations such as the World Resources Institute, U.S. Council on Environmental Quality and the National Wildlife Federation to understand that the condition of the planet's resources has not improved and in most areas has actually declined. Hungerford and Volk (1990) summarize this by saying:

> Regardless of what we as educators would like to think, we can point to relatively few successes that offset the severity of environmental degradation....: This is a bitter concept for educators to accept. Although we are prone to defend our practices in EE, we must stop and evaluate how successful we are in the overall battle to resolve urgently important environmental issues. (p.15)

Curricula that provide the necessary knowledge related to the issues, tools to adequately analyze and evaluate issues, and skills to help resolve issues are essential. These ingredients are proven links to success in promoting environmental behavior.

If environmental educators are to achieve, with some degree of success, the ultimate goal of responsible environmental behavior, then it becomes critical to design materials suited to the task. Curricula that provide the necessary knowledge related to the issues, tools to adequately analyze and evaluate issues, and skills to help resolve issues are essential. These ingredients are proven links to success in promoting environmental behavior.

Environmental Issues: An Inherent Part of Environmental Education

While responsible environmental behavior is a major goal of EE, a focus on environmental issues is one of the main vehicles through which this goal is achieved. By simple definition, an issue involves a problem about which there are differing beliefs and values (Ramsey & Hungerford, 1989). It is these differing beliefs and values that often hinder the resolution of the most pressing environmental problems.

Environmental issues are also the cause or the mechanism that typically propels individuals to take action. It seems evident that an individual must be cognizant of an issue before he/she can engage in an environmental behavior directed towards its remediation (Iozzi, 1981).

It would appear then that environmental issues are an integral part of EE and should form an important part of curriculum development. In fact, over the last 15 years, curricular goals in EE (Hungerford et al., 1980) as well as science education (Harms & Yager, 1981) and science/technology/society education (Rubba & Wiesenmayer, 1985) have been developed which contain an emphasis on issue instruction. Reports in science and social studies education can also be found that argue the public's need to know about science-related social issues (which include environmental issues) in order to make responsible decisions (Simpson, 1989).

While the demand for more issue instruction in the schools is apparent, much of the issue related materials that do appear in textbooks (and other sources used in the schools) provides only an awareness level account. Little opportunity for in-depth student issue investigation or training in issue resolution can be found (Ramsey, Hungerford, & Volk, 1989). More importantly, the incorporation of in-depth issue instruction that presents all sides of an issue, presents alternatives and lets students decide on possible actions to remediate the issue is both lacking and much needed in schools today.

If environmental issues are to become an integral part of instruction designed to change behavior, instruction must go beyond an 'awareness' or 'knowledge' of issues. Students must be given the opportunity to develop the sense of 'ownership' and 'empowerment' so that they are fully invested in an environmental sense and prompted to become responsible active citizens. (Hungerford & Volk, 1990, p.17).

Few environmental educators would argue the importance of dealing with critical issues. If responsible environmental behavior is the ultimate goal, then issues should be the focus of instruction . . . "because all environmental behavior is somehow issue related" (Hungerford & Volk, 1990, p.17).

Goals and Objectives for Environmental Education Curriculum Development

Another concern for EE programs has been the general lack of direction, particularly in the area of goals for curriculum development. Specifically, goals that incorporate strategies designed to change behavior have been lacking or perceived as so very complicated as to make instructional planning difficult (Hungerford & Volk, 1990). We see then a plethora of EE programs addressing goals at the ecological knowledge and awareness levels but few addressing goals that engage students in issue investigation, citizenship action skills training, and participation in environmental problem solving.

The answer to some of these concerns might be found in a set of instructional goals for EE developed by Hungerford, Peyton and Wilke (1980). These "Goals for Curriculum Development in Environmental Education" (GCDEE) were derived from the Tbilisi Declaration's objectives for EE and have been validated by a national panel of environmental educators.

This set of goals provide a substantive structure and framework for EE and continues to serve as a basis for curriculum development throughout the world. These goals represent a comprehensive model that incorporates knowledge, awareness, issue investigation/ evaluation and citizenship action skills training. The goals are presented to the right.

Using several instructional methodologies that incorporate these goals for curriculum development, a number of researchers have reported that instructional techniques organized around the GCDEE do in fact foster responsibleenvironmental behavior at various grade levels (Culen, 1994; Holt, 1988; Klingler, 1980; Ramsey, 1993; Ramsey and Hungerford, 1989; Simpson, 1989). In addition, these research studies tend to confirm that environmental curriculum models directed at the science/ecological foundations and awareness levels (Levels I and II of the GCDEE) do not significantly facilitate transfer to environmental problem solving and subsequent environmental action (Culen, 1994; Ramsey et al, 1981).

The importance of clearly stated, well defined goals should not be underestimated. Curriculum specialists, in general, agree that irrespective of the subject, goals are needed to provide a sense of direction for curriculum development and instruction (Saylor & Alexander 1974). Using the GCDEE, specific objectives can be written which would serve to operationalize these goals and provide a rational basis for instruction, and the subsequent evaluation of that instruction. With these GCDEE in hand, environmental educators have the basis to develop appropriate materials that focus of the critical components that help produce the ultimate goal in EE, responsible environmental behavior.

Goals for Curriculum Development in Environmental Education

The Superordinate Goal

. . . to aid citizens in becoming environmentally knowledgeable and, above all, skilled and dedicated citizens who are willing to work, individually and collectively, toward achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment.

Goal Level I: The Ecological Foundations Level

This level seeks to provide learners with sufficient ecological knowledge to permit them to eventually make ecologically sound decisions with respect to environmental issues.

Goal Level II: The Conceptual Awareness Level: Issues and Values

This level seeks to guide the development of a conceptual awareness of how individual and collective actions may influence the relationship between quality of life and the quality of the environment and, also, how their actions result in environmental issues that must be resolved through investigation, evaluation, values clarification, decision making, and finally, citizenship action.

Goal Level III: The [Issue] Investigation and Evaluation Level

This level provides for the development of the knowledge and skills necessary to permit learners to investigate environmental issues and evaluate alternative solutions for solving these issues. Similarly, values are clarified with respect to these issues and alternative solutions.

Goal Level IV: Action Skills Level: Training and Application

This level seeks to guide the development of those skills necessary for learners to take positive environmental action for the purpose of achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment. (Hungerford, Peyton & Wilke, 1980)

Research on Environmental Behavior and Associated Variables

Environmental behavior has been examined by a number of researchers and their studies have investigated behavior from a number of perspectives. Some have examined specific treatment variables (Asch & Shore, 1975; Culen, 1994; Horsely, 1977; Klingler, 1980; Ramsey, et al., 1981; Ramsey, 1987, 1993;Ramsey and Hungerford, 1989;Simpson, 1989). Others have studied the relationship between a number of environmentally related variables (Arbuthnot, 1977; Borden & Schettino, 1979; Bruvold, 1973; Kronus & Van Es, 1976; Marcinkowski, 1987; Sia, 1984; Sivek, 1988).

Despite the wealth of information which exists concerning environmental behavior, it is not entirely clear to many environmental educators and curriculum developers which variable or variables appear to be most influential in motivating individuals to take responsible environmental action (Hines, et al., 1987).

It becomes apparent, then, that a greater knowledge base within EE concerning the relationships between knowledge, attitudes and behaviors is needed. It may in fact be critical considering that:

> The success of public policy decisions, educational programs and other efforts dependent upon specific individual action in the realm of environmental issues may well hinge upon our understanding of the relationship among personality characteristics, attitudes, environmental values, knowledge and behaviors." (Arbuthnot, 1977, p.217)

Hines, et al., (1987) published a meta-analysis of research on environmental behavior which had been conducted over a ten year period. The purpose of the study was to identify those variables which were the best predictors of environmental behavior. The researcher analyzed 128 studies from which a set of variables was identified which appear to be critical for the occurrence of environmental behavior. From this analysis, a model of responsible environmental behavior evolved. This model is displayed in Figure 1.

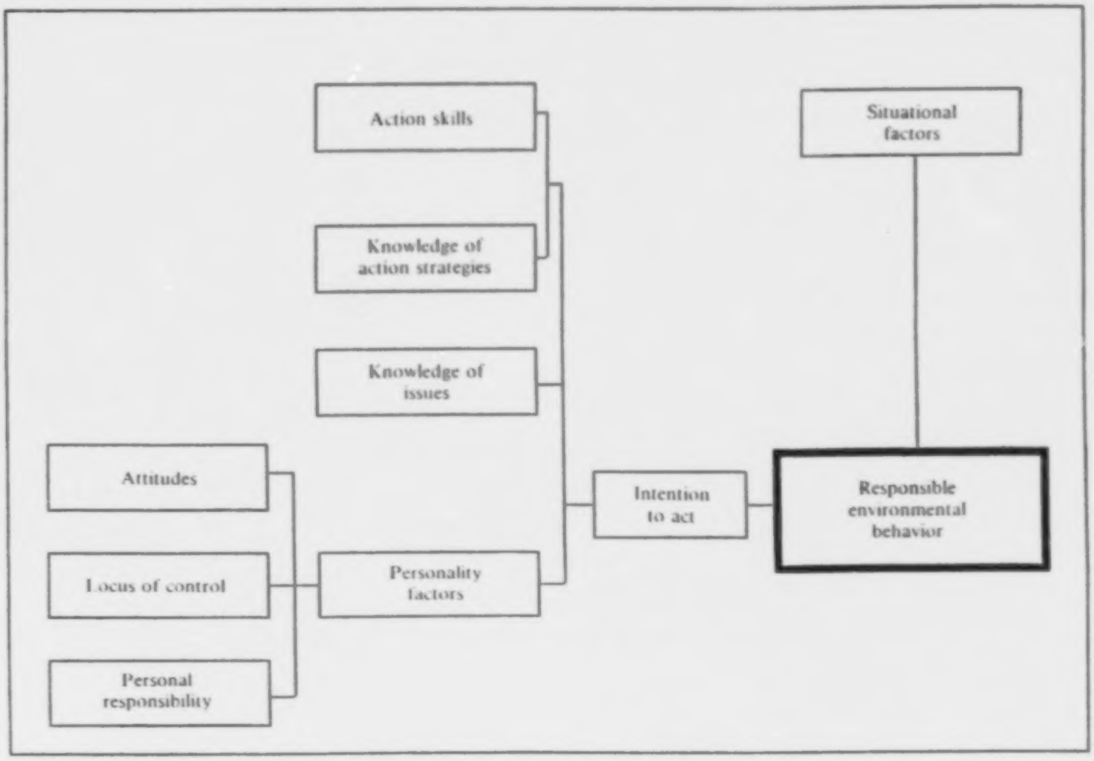

Figure 1. The Hines Model of Responsible Environmental Behavior. (Adapted from Hines et. al. (1986/87).

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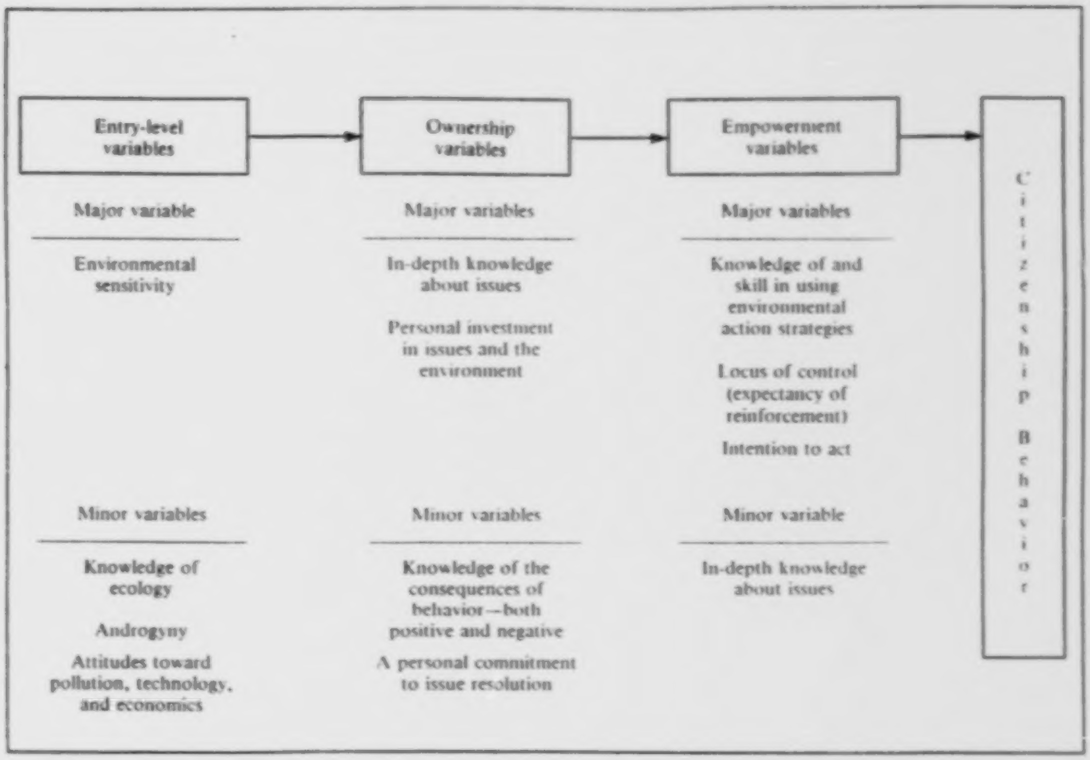
Entry-level variables
Ownership variables
Empowerment variables
Citizenship Behavior
Major variable
Environmental sensitivity
Major variables
In-depth knowledge about issues
Personal investment in issues and the environment
Major variables
Knowledge of and skill in using environmental action strategies
Locus of control (expectancy of reinforcement)
Intention to act
Minor variables
Knowledge of ecology
Androgyny
Attitudes toward pollution, technology, and economics
Minor variables
Knowledge of the consequences of behavior—both positive and negative
A personal commitment to issue resolution
Minor variable
In-depth knowledge about issues

Figure 2. Environmental Behavior Model: Major and Minor Variables Involved in Environmentally Responsible Citizenship Behavior. Hungerford and Volk, 1990, p.11)

The variables in the Hines model, acting together, help explain and account for the development of citizens who are willing and able to make responsible environmental decisions and act on those decisions. It should be pointed out that while these variables were seen to have the strongest relationship with environmental behavior, a degree of uncertainty still exists in the prediction of environmental behavior due to the complex process which is based on a multitude of factors (Hines, et al., 1987).

Using the Hines model and related research, Hungerford and Volk (1990) presented a modified model for environmental behavior at the "World Conference on Education for All - Meeting Basic Learning Needs" sponsored by UNESCO, UNDP, UNICEF and the World Bank held in Jomtien, Thailand, March 1990. This current model or "behavior flow chart" as seen in Figure 2, details three probable categories of variables that contribute to environmental behavior. One category is entry-level variables which are described as good predictors of environmental behavior or ones that appear to be related to environmental behavior. The authors also state that these appear to be prerequisites or variables that would enhance a person's decision making, once an action is undertaken.

Ownership variables are those that make environmental issues personal. The individual feels a part of, identifies strongly with or "owns" the issue. The authors consider these variables critical to responsible environmental behavior.

Empowerment variables are thought to be crucial in the training of responsible citizens in the environmental dimension. These variables give individuals a sense that they can make changes and help resolve environmental issues. These variables are viewed by the authors as cornerstones of training in EE but are often neglected in educational practice.

Hungerford and Volk (1990) hypothesized that these variable categories "act in more or less of a linear fashion, albeit a complex one." (p.10). The

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discussion of the variables listed in the behavior flow chart also suggest certain synergistic relationships between closely related variables.

> The reader is cautioned to keep in mind that all of the variables discussed probably operate in some sort of synergistic manner. While the categories of variables probably operate in a linear fashion, the variables within each category do not necessarily operate in a similar manner. (Hungerford & Volk, 1990, p.11)

While this model for environmental behavior presents an updated and comprehensive view of variables influencing environmental behavior, the developers, along with most of the previous researchers concur that even more research is needed to completely understand environmental behavior and the variables that appear to be associated with it. When considering what researchers know about environmental behavior, it becomes evident that EE instructional methods that limit the focus to knowledge and awareness will not, in most cases result in behavior change (Leeming, Dwyer, Porter, & Cobern, 1993). Indeed, these studies and resulting models substantiate the need for EE curricula which incorporate the variables that appear critical in developing responsible environmental behavior. One can infer from these findings that a message for environmental educators is clear. If the goal is to produce environmentally responsible citizens then these predictors must be addressed and put into instructional practice.

It becomes apparent, then, that a greater knowledge base within EE concerning relationships between knowledge, attitudes and behaviors is needed.

The Status of EE Curriculum

While it is widely accepted among professionals that EE should be infused throughout the curriculum at every grade level (Disinger, 1987; Engelson, 1985; Hart, 1981; Hungerford, 1975; Jinks, 1975; Stapp, 1978), a great deal of evidence indicates that this integration is not occurring (Simmons, 1989). Pomerantz (1991) reported that in a review of 700 lessons in resource management and EE, most of the lessons' objectives focused squarely on specific content areas with little attention being given to the integration of EE materials in various disciplines and at all grade levels. This is very unfortunate because there are many opportunities to integrate exciting EE materials across almost all of the disciplines and at all grade levels. EE should not become another add-on to the already overburdened school schedule. Thoughtful curriculum planners know that episodic treatments only in certain courses must be avoided (Ramsey et al., 1981).

When [educators are] considering what researchers know about environmental behavior, it becomes evident that EE instructional methods [and materials] that limit the focus to knowledge and awareness will not, in most cases result in behavior change . . . .

There are several possible explanations for the lack of integrating EE materials. The first encompasses the materials themselves. By and large these materials are knowledge based, providing information about ecology, the environment and environmental problems. Lessons also tend to be weak in providing adequate background information for the teacher and lack criteria to evaluate student performance (Pomerantz, 1991). These types of deficiencies would have a tendency to erode teacher confidence, especially for those who perceive themselves as having little science background. Another explanation for not incorporating EE materials into the curriculum might lie with science teachers who perceive themselves as the best qualified to teach EE and therefore limit instruction to science classes. Supporting this explanation, Ham and Sewing (1987-88) argue that when EE is included within teacher preparation programs it is usually found in science methods courses. Teachers then conclude from their training that EE fits best in the science class.

Teachers need not be scientists to engage students in the exploration of environmental issues or action strategies. What teachers need are EE materials within the normal scope and sequence of subject areas that environmentalize the total school curriculum, not just science. If EE is committed to the role of infusion in the schools, then it is obvious that curriculum materials should be developed for use by non-science teachers within non-science subject areas (Simmons, 1989).

Volk (1983), in a national survey of curriculum needs as perceived by professional environmental educators, also reported a greater emphasis in the existing curricula on the lower level EE goals (knowledge and awareness) than on the higher level

EE goals (investigation/ evaluation and citizen participation). Her results indicated that a discrepancy existed between the environmental action goals educators believed to be important and their perceptions of what was actually being accomplished through education.

Using a screening instrument based on the format of Gardella's EE Curriculum Inventory (1986), Pomerantz (1991) reviewed 72 instructional guides and programs containing over 700 lessons. The instructional goal most emphasized was knowledge about the environment, found in 64.7% of the lessons, while goals on behavior and responsible stewardship were found in only 10.7% of the lessons. Pomerantz concluded that most natural resource education materials are designed to address basic knowledge of ecological principles, with little attention given to specific resource management issues, and lessons that encourage environmentally conscious behavior.

A more recent study by Andrews (1992) examined 75 water related curricula to assess the thrust and needs for water education programs directed at nonformal youth audiences. In the curriculum assessment process, Andrews used an EE skills list based on recognized efforts to identify needs (UNESCO, 1978) and to develop a taxonomy of EE objectives (Hungerford et al., 1980; Roth, 1990). The pattern of results in this curriculum review is similar to the others. Ecological foundations were found in the vast majority of reviewed materials. Attention to conceptual awareness of environmental issues and values was described as high. Again, a lack of materials involving the investigation, evaluation and environmental action skills was demonstrated. Andrews (1992) states:

> Gaps in the curriculum indicate that there is a need to highlight how investigation and evaluation skills can be transferred to personal life decisions. (p.16)

. . . the implications are clear. The ultimate goal of environmental behavior is not being addressed to a great enough extent in the existing programs and curricula.

From these studies, the implications are clear. The ultimate goal of environmental behavior is not being addressed to a great enough extent in the existing programs and curricula. However, this discussion about the status of EE curricula should not be considered a deterrent for educators but a challenge. Well developed, effective EE programs can and do exist, although there remains a need for more. It is up to curriculum developers to produce them and educators to identify and use them (Niedermeyer, 1992).

Summary

This review has established the fact that a clear and comprehensive set of goals exists for the field of environmental education and for curriculum development within the field. This review has also presented a consensus that responsible environmental behavior is the ultimate goal for EE. Further, several theoretical models have been proposed that serve as foundations for the development of curriculum materials capable of attaining this goal. It is evident from the review of research on EE materials and programs that additional curricular materials, specifically in the area of issue investigation/evaluation and action training, are needed. The evidence indicates that the ultimate goal of EE, to promote responsible environmental behavior, is achievable through these educational methodologies.

Consider the following statement by Hungerford and Volk (1990):

> The research is very clear on the matter. Citizenship behavior can be developed through environmental education. The strategies are known. The tools are available. The challenge lies in a willingness to do things differently than we have in the past. (p.17)

It is evident from the review of research on EE materials and programs that additional curricular materials, specifically in the area of issue investigation/evaluation and action training, are needed.

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Two Hats

John Hug

Two decades ago John Hug wrote this very short and extremely meaningful "editorial" as a preconference paper for the North American Regional Seminar on Environmental Education for the Real World. What makes this reading important are the following: (1) there is still some debate as to whether environmental educators should be environmentalists under the same umbrella that they wear professionally; and (2) the writer focused an operational definition of an environmental educator squarely where it belonged. Seldom has so much been said in so short a space!

It would appear that environmental educators have a bad case of the "two hat" problem. We have come by the problem naturally and, therefore, we have paid little attention to it.

The problem is simply that industry, utilities, labor, business, media and other segments of the population and the general public have consistently recognized only one hat when talking about environmentalists and environmental educators. It is not uncommon for dedicated environmental educators to be summarily dismissed as troublemakers - environmentalists. This one hat view is easily explained because environmental educators are almost always environmentalists. Perhaps definitions will help clarify the problem.

Any world citizen who advocates with greater or lesser action that wrongs against our environment must be stopped is an environmentalist. Perhaps the negative reputation environmentalists have stems from the dramatic and radical actions of a few.

An environmental educator, on the other hand, is any world citizen who uses information and educational processes to help people analyze the merits of the many and varied points of view usually present on a given environmental issue. The environmental educator is not the "mediator," "trade-off specialist" or "negotiator," but a developer of skills and an information analyst who prepares the people (from any segment of the population) who will participate in environmental decision making.

Environmental educators, therefore, need to be as "value fair" or "value free" as they can when working in this role. They must scrupulously strive to get all the facts, examine and illuminate all the viewpoints, and keep from letting their own particular position (as an environmentalist) from mixing with their educator role.

My suggestion is simply that environmental educators make an effort to clarify the two distinct roles. At every opportunity, we should emphasize the neutral nature of environmental education activity. Strong advocates are all around us, each using the techniques of persuasion and propaganda to build their constituencies. We must, ourselves, be familiar with all sides, stand firm for each advocate's right to be heard, and provide a rational stage for informed debate.

Environmental educators have the right and the duty to be environmentalists, but the dual roles must adhere to the original premise - to keep each hat on its proper head, while utilizing to the fullest the professional skills of the environmental educators.

An environmental educator . . . is any world citizen who uses information and educational processes to help people analyze the merits of the many and varied points of view usually present on a given environmental issue.

Originally in Aldrich, James L., Blackburn, A.M., & George, A.A. (Eds.) (1977). *The Report of the North American Regional Seminar on Environmental Education for the Real World*. Columbus, OH: SMEAC Information Reference Center.

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"I think the best benefit - there's been many but, the best benefit has been the curriculum package . . . learning is not so much . . . memory but it reaches higher order thinking skills and has the students responsible for far more of their own education than they're used to. Having this curriculum that outlines procedure - a process to do a research project in environmental education - was a great help. I mean, I've been doing project-based learning for most of my thirteen year career because I believe in it, and I think it's best for kids. . . . it is a very complicated process but within that process are steps that need to be mastered to get to the final goal. You can't just say, okay, we are going to do a high quality research project and we are going to do a quality presentation or a demonstration of learning or whatever it is that the final outcome turns out to be in terms of an action.

Without going through these steps of understanding - like how to write a research project - there are so many little pieces of understanding - how to do research properly without spinning your wheels and wasting time. I deal with middle school students and, for these students, this a hard thing for them to do - to master these little pieces that are part of a very large whole. If you don't get through those pieces and teach them how to do some of the things we take for granted in a project-based learning environment they won't be as successful. They will struggle and they will be frustrated. And I think that's what this curriculum does. It provides a structure to the learning environment that must have taken a tremendous amount of time and thought to put together.

I think it comes from the same educational philosophy - the constructivist approach to education that works for kids. . . . it's been very well thought through, the pieces of the learning process that need to be in place for a quality project to emerge at the end are there for the teacher to implement in the form of little mini lessons and experiences, the readings, they are all part of a very complex whole. And you don't ever use them all, at least I didn't when I went through the classes, but I could pick and choose from what was there. I found that very helpful. But in terms of my teaching process, it was a clear match."

An Alaskan Middle School Teacher. From an interview conducted with him by Versil Withrow, Workshop Coordinator for The Center for Instruction, Staff Development and Evaluation, 1997.

The Myths of Environmental Education - Revisited

Harold R. Hungerford

Myths surround many human endeavors and environmental education is no exception. Over two decades ago Dr. Hungerford wrote the original "Myths of Environmental Education" for The Journal of Environmental Education (Vol. 7, No. 2, Winter 1975, pp. 21 -26). In that article Dr. Hungerford discussed what he believed to be some of the most prevalent myths of the day. In his opinion, many of these myths continue as the year 2000 approaches. Not too surprisingly, some of these myths need additional comment and new myths have emerged. In the reading that follows - written in the first person - some of the original article remains, but it is substantially revised and abridged with new material added.

Over the years, I have read numerous publications dealing with environmental education only to find that far too many of them, for one reason or another, present over-generalizations, questionable logic, myths, pedagogical excesses, simple untruths, and at least a modicum of hypocrisy! Further, I find that university students are often confused and somewhat frustrated by the large number of divergent ideas that confront them. Many students, for example, come to class assuming that outdoor education and environmental education are synonymous. Many others believe science education to be the sole vehicle for environmental education. Some even accept without question the notion that scientists and/or technologists will one day pull on some sort of technological lever and solve once and for all the problems of hunger, population, energy shortages, and the various forms of pollution. These ideas, among others, are substantial components of the mythology of environmental education.

All of these observations and personal interactions with people and with the literature prod me to set down what I believe to be at least some of the major myths where others can see them and react to them. Some of the myths on this list may irritate particular readers, but these ideas need to be explored and debated if necessary. In the end, such a discussion might well clarify pedagogical excesses that seem to be alive and well in an oftentimes over-zealous EE community. If clarification comes forth, students everywhere and at all grade levels will be served.

[Many] EE books and articles, for one reason or another, present over-generalizations, questionable logic, myths, pedagogical excesses, simple untruths, and at least a modicum of hypocrisy!

Myth Number One: Ecology and Environmental Education are Synonymous

The recent surge of environmentally concerned articles and position statements identify a substantial diversity of opinion as to what constitutes the domain of environmental education. As noted before, there are those definitions that seem to indicate no limits to the field. Some authors - foolishly in my opinion - even portray environmental education as being synonymous with ecology. It is not so much that these writers intend to misrepresent ecology; they simply collapse for practical reasons perhaps, all of the environmental problems of the planet into a neat, publicly acceptable package called "ecology." This confusion can do irreparable harm to a concept of ecology for both teachers and students. Ecology, per se, is a science and is not value-laden; environmental education most certainly is not a science and it is value-laden! Thus, we find a situation where readers are inno-

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Ecology is: The science that studies interrelationships within and between plant and animal populations, and with their non-living environment.

cently led toward an erroneous and potentially debilitating concept.

Simply stated, ecology can be defined as the science that studies interrelationships within and between plant and animal populations, and with their nonliving environment. This definition is a far cry from environmental education.

Myth Number Two: Outdoor Education . . . and Environmental Education Are Synonymous

Identifying this statement as a myth may raise the ire of a number of readers because at least some outdoor educators have coveted the environmental education movement in order to bring new relevance to outdoor education. And, certainly, there is little wrong with this action, because *all* educators must bear responsibility for environmental education. Even so, to deal with the two fields as synonyms does serious injustice to both. Much in environmental education can be conducted using outdoor education strategies, because it is often outside the classroom where environmental problems and issues exist. But, outdoor education, much as science and social studies, goes far beyond the domain of environmental education.

Not only do we find outdoor education being sometimes mislabeled as EE, we also get confused about some other pursuits that have substantial Venn diagrams with environmental education. Just because some EE or related pursuits overlap, this does not mean that they are the same things. What about pursuits like "interpretation", "conservation education", "environmental science", wilderness education, and even some aspects of recreation? It is my opinion that we do all of these things an injustice when we mythologize them as being synonymous with EE. Thus, not only do educators and others become confused about EE, they also become confused about these other areas as well. This is unfortunate and a disservice is rendered all around.

Myth Number Three: EE Can Be All Things to All People

Over the years, many writers and agencies have attempted to define environmental education in a manner that establishes parameters for the field as well as focusing on important content. A major problem with many of these definitions has been their cumbersome nature, i.e., they are terribly complex and, therefore, difficult to interpret. A classic case in point is that definition reported many years ago in the U.S. Senate report on the Environmental Education Act:

> Environmental education is an integrated process which deals with man's interrelationship with his natural and man-made surroundings, including the relation of population growth, pollution, resource allocation and depletion, conservation, technology, and urban and rural planning to the total environment. Environmental education is a study of the factors influencing ecosystems, mental and physical health, living and working conditions, decaying cities, and population pressures. Environmental education is intended to promote among citizens the awareness and understanding of the environment, our relationship to it, and the concern and responsible action necessary to assure our survival and to improve the quality of life.

Using this definition, one can safely assume that environmental education must be almost all things to all people. The only problem with this is that, if we make this assumption, then EE probably becomes nothing to anyone. Indeed, it seems to me that EE must have boundaries which allow educators to make sound decisions not only about what it is and what it is not but also decisions about how to go about educating learners wisely and doing research correctly. By broadening the field to make certain that we placate everyone everywhere, we trash these very important promises of EE.

By broadening the field [of EE] to make certain that we placate everyone everywhere, we trash ... very important promises for EE.

The efforts to define EE have gone on far too long - almost thirty years - with too much controversy and argumentative ardor. Over the years I have been involved in this argument - perhaps better called a debate - but of late I have been quite willing to cast even my own definitions aside for another from the *Federal Register* (Friday, October 16, 1992) which is about as terse as it can be and amazingly easy to understand. This definition follows:

> *Environmental education is a process that leads to responsible individual and group actions. . . . Environmental education should enhance critical thinking, problem solving, and effective decision-making skills. Environmental education should engage and motivate individuals as well as enable them to weigh various sides of an environmental issue to make informed and responsible decisions.*

Myth Number Four: A Humanistic Approach to Environmental Education Can Be Equated with Unlimited Student Freedom

The appeal for humanism in education is often closely associated with the environmental education movement. A humane educational perspective should, of course, be an integral component throughout education. If environmental education can help increase compassion and respect for individuals, so much the better! But there are some rather dogmatic contingencies placed on humanism in environmental education that don't hold up logically under inspection. One of these seems to equate humanism and student autonomy with respect to choices for issue investigation. Further, it can be inferred that said issue investigations must be unencumbered by teacher-guided discovery, or worse, some didactic teaching.

To indulge in this poorly thought out perspective heaps criticism on thousands of competent and truly humane teachers who manage exciting, productive, instructional programs for students at all grade levels. Many teachers at both secondary and college levels who are reputed (by their own students) to be extremely competent and humane manage rather structured classrooms. Even so, I would no more equate structure with humanism than equate environmental education solely with instruc-

> **Many teachers at both secondary and college levels manage exciting and productive instructional programs while, at the same time, supervising rather structured classrooms.**

It seems critically important to remember that humanism is an attitude toward other human beings that reflects the best of human interests and ideals. Humanism is largely a state of mind and communication of caring between individuals. It is not synonymous with a particular instructional methodology and can be reflected successfully in many different ways. Similarly, educational humanism can be sought and implemented in any sound instructional strategy. And, importantly, environmental education is not the sole owner of human ideals and compassion.

Myth Number Five: Students Are Natural Investigators and Can, without Special Training, Successfully Engage in and Bring Closure to Environmental Issue Investigations of Their Own Choosing

This myth has gained more press over the past twenty years than many of the others. There are those who firmly believe that the educational experience must find its own sources of knowledge and provide unlimited freedom to gain skills and make choices. Unfortunately, there is little evidence to support this contention.

Those who know me well know that I find no argument with the need for involving learners in serious environmental issue investigations at least at the community level; nor do I find argument with the notion that many students are curious and natural investigators. The argument and the myth lie in the much heralded but erroneous assumption that ***untrained*** students can successfully choose, engage in, and bring closure to environmental investigations or problem-solving strategies.

Certainly, there are simple, unsophisticated investigations that can be conducted by children at many ages. I have observed, however, many middle school students, who have been given complete autonomy in choosing environmental issues to investigate, become completely frustrated in their ability to bring closure to these inquiries.

Intensive observation at the middle school level (over a period of almost two decades) indicates that students generally cannot identify the means of data collection, cannot correctly communicate data, cannot logically interpret data, much less write a research question that delimits and focuses on the problem in question. These observations were also made within a climate where instructors and the students wanted this kind of environmental education. Further, the instructors were, in my opinion, exceedingly humane in their dealings with students.

The question, of course, is simply one of why middle school students couldn't bring closure to problems of their choosing. The answer is equally simple. The students didn't have the cognitive skills necessary to allow them to bring closure to their investigations. The students simply could not discover how to discover.

It will rankle a number of environmental education theorists to hear that before one can ***unstructure*** the classroom for autonomous research, one must structure an instructional program which focuses on selected cognitive skills. Even so, this is precisely the case!

This very popular myth is thoroughly entrenched in the minds of numerous environmental educators both within and beyond the borders of the United States.

It is hoped that the myth will die quickly so that students the world over can be given some options that will permit them to successfully engage in critical problem-solving activities that will help clarify values and create a more environmentally literate and effective population.

Myth Number Six: Don't Worry, Everything's Gonna Be All Right - The Projected Theory Syndrome

> Our circuits are already over-loaded with a multitude of 'world shaking' problems, and we want desperately to believe that science or superman or some unknown factor X, will magically and simply solve these complex problems. We are frequently lulled into a false sense of security by glowing reports from technological optimists who fail to understand ecology, thermodynamics, and the mathematical implications of a J-curve. We read in the newspaper about some breakthrough, not realizing the thermodynamic and economic differences between discovering something in the laboratory and carrying it out on a world-wide scale.
>
> G. Tyler Miller

To teach that technology has decision-making abilities is particularly cruel to students.

The Projected Theory Syndrome pervades a good many classrooms and far too much of the literature. Self-styled authorities perpetuate the notion that environmental evils are and will continue to be amenable to scientific and technological solutions. It is, basically, a firm belief in the "power" of science and technology to come forth with the mechanisms whereby environmental problems will be resolved. Unfortunately, this view is sometimes presented in the classroom, not as one point of view or a philosophical perspective, but as an absolute!

The arch enemies of the Projected Theorists are supposedly the Ehrlichs, Commoners, and Hardins, those who are stimulated stubbornly to warn the world's citizenry of possible ecological calamity. To the Projected Theorists these folks fail to free man of the fear of an uncertain ecological future. The Projected Theorists dismiss the harsh warnings about what may happen one day if . . ..

The notion that science and technology contain an inherent ability to solve the environmental issues that plague mankind is one that most human beings would like to hold since it diminishes the trauma associated with potential ecological disaster. Because it soothes the "ulcer of environmental concern" for many uninformed citizens, the Projected Theory is not tested logically and its basic weaknesses are not perceived. For example, to assign solution potential to science is completely without substance. Science provides us with only the empirical findings by which we must find our own solutions to environmental issues using technological or other means.

To teach that science and technology have decision-making abilities is particularly cruel to students who then misconceptualize the true parameters of these human enterprises and, further, fail to see any need for developing an environmental ethic themselves.

Myth Number Seven: The Only Person Who Can Successfully Teach environmental Education Is the Science Teacher

In schools where environmental education is a reality, it is typically the science teacher who has this responsibility. This is true for a number of reasons. Among them is the equation of ecology with environmental education (see Myth No One). Similarly, the science teacher probably feels more comfortable with the topic than his peers, and administrators quite often look toward the science people for leadership in this area. Unfortunately, all of this helps demonstrate the misconceptions associated with environmental education as well as the intolerable poor training of teachers and administrators for effective leadership in environmental education.

An excellent argument can be made for infusing environmental education into the social studies. If the reader sees environmental issues as being more sociocultural than science-technological, the social studies should become a logical place for EE. Certainly the issues involved are value-laden, a characteristic somewhat foreign to classical scientific fields. Environmental education is multidisciplinary and, where personnel can plan and work cooperatively, a team approach would more appropriately reflect its true nature than any other strategy.

Myth Number Eight: Environmental Educators Always Practice What They Preach

I would like to assume that all educators are environmental educators, however absurd that assumption appears initially. Probably it would be far more logical to state that all educators should be concerned about the environment and engage in educating the populace relative to their tenuous existence in the biosphere. In any event, educators must be willing to behave in environmentally literate ways before they can expect youth to do likewise.

As with any other moral responsibility, there is bound to be at least a bit of hypocrisy. What bothers me is the observation that there are professionals in environmental education who act as though environmentally responsible behavior is something for the other fella. For example, there are those of us who drive vehicles that are less than fuel efficient; there are those of us who fail to recycle; and there are those of us who ride when we could walk, etc. What we all, at times, tend to forget is that these kinds of behavior are what creates most of our environmental problems in the first place.

Myth Number Nine: Almost Anybody Can Be a Curriculum Developer

Myth Number Ten: Intuitively-Based Curricula Are OK

Myth Number Eleven: Almost Anybody Can Evaluate Environmental Education Programs

Myth Number Twelve: When Environmental Education Programs Are Evaluated, for the Most Part, They Are Just Fine

No entities - individuals or agencies - like to hear that the materials they have produced are of questionable value! It is precisely this relationship between materials development and evaluation that tie Myths Nine, Ten, Eleven, and Twelve together.

A plethora of EE materials exist, and many of these receive enormous amounts of publicity and funding. If one looks at these materials and then at an empirical validation of them, you quickly observe that there is very little research out there that confirms the success of many of these programs to do much of anything let alone change citizenship behavior.

This tragedy exists in an educational environment where research does exist that points directly to the development of programs that can impact dramatically on responsible environmental behavior. We know a great deal about the precursors to responsible environmental behavior, and we have very strong evidence that certain sequences of instruction will impact dramatically on these precursors resulting in substantial changes in responsible citizenship behavior. Still, those who are "in charge" of the widely publicized programs have committed so strongly to intuitively-based instructional designs that they simply dare not make the decisions that might dramatically impact on learners and issues across the nation.

> **The research is very clear on the matter. Responsible citizenship behavior can be developed. The strategies are known and the tools are available - the real challenge lies in doing things differently than we have in the past.**

Critics of this position will be quick to counter with anecdotes describing citizenship actions that "prove" me wrong. This might sound convincing except for a couple of problems: (1) these anecdotes are, by and large, episodic, i.e., they do not represent autonomous decision-making by large numbers of learners over long periods of time; and (2) these anecdotes are typically teacher-driven and not learner-driven. In other words, the teacher remains responsible for learner decisions instead of turning that responsibility over to the students. Turning this responsibility over to the students would result in a student commitment to the environment instead of the teacher's commitment. We simply do not seem to be able to accept the notion that citizenship decisions should be student-driven using evaluative screens that will help students make mature, responsible decisions.

I am very tempted to add another myth to the mix here, albeit the fact that it might be overkill. However, for those readers curious as to what it might be, it follows. This myth might read: "EE curriculum developers use research findings in the development of environmental education curriculum programs." And, maybe this myth rankles me just as much as the others in this grouping, because we fail hundreds of thousands of young learners by doing just the opposite - again, developing curricular materials intuitively. It is that old linear equation again. We want to believe in all desperation that knowledge leads to attitude changes which leads to action in the environmental arena. It simply is not true for large numbers of learners! It is simply not true, and it never has been and never will be!

> **We want to believe in all desperation that knowledge leads to attitude changes which leads to action in the environmental arena. It simply is not true for large numbers of learners! It is simply not true, and it never has been and never will be!**

When one puts programmatic evaluation into the mix we find yet another variable that keeps EE from entering into a new era of responsible instruction. Oftentimes we avoid truly rigorous evaluations of our material for very selfish and face-saving reasons. This can bring into play that old tongue-in-cheek research proverb which states, "If you want to guarantee validity make certain that your validity panel is composed of your lover, your mother, and your minister!" Of course, this is absurd. But, how many constructs, theories, models, etc. can you count that have been based on validity decisions made by nationally-reputed professionals? Far too few!

Unfortunately, poor evaluation - either before or after the fact - will most probably result in programs that purport to do things other than what they actually do. Many programs either claim to change citizenship behavior or write goals for so doing. Then we find that these same programs do little other than provide students with more ecology and/or issue awareness, neither of which will change learner behavior if autonomous citizenship responsibility is the goal.

When one compares the impact of these latter four goals against the others in this reading, these four myths may prove the most disastrous over the long run.

Myth Number Thirteen: It Is the Responsibility of Environmental Educators to Teach Learners Appropriate Values

I recall with much amusement helping to teach an international workshop in issue investigation and evaluation a few years ago. In the room were thirty-some educators from the U.S., Mexico, Canada, and South America. When I stated that we in the room did not comprise a homogeneous group of environmental educators, we almost had a riot. Participants were very upset and claimed that everyone there had the same focus for learners.

Then I asked the participants to respond to ten statements tied to Likert items going from "strongly disagree" to "strongly agree". When the results were reported by the participants themselves, they were shocked to find that there were traitors in the room. Not everyone shared the same values - not by a long shot.

Even today we run across more than our share of teachers who are convinced that it is their responsibility to teach appropriate values. Why? Reasons vary but some of them are: (1) "I know what is best! I know what the issue solutions should be!"; (2) "If we let young learners make their own value decisions, we cannot trust them to make good ones!"; and (3) "These kids are too young to be able to analyze values - those of others and themselves."

It is unacceptable to teach learners what their values should be - totally unacceptable! Conversely, it is totally appropriate to teach learners how to identify the values of others, especially during a process that we call issue analysis. It is critically important for young people (and adult learners as well) to be able to critically analyze environmental issues and identify the players, their beliefs and their values. Only in this way can learners understand the anatomy of issues! If they inspect their own values during this process, alright. However, this is not and must not become part of the assignment!

Myth Number Fourteen: Environmental Education is a Substantial Help to the Environment Overall

One might wonder if environmental education - in its present state considering the myths and EE's other problems as well - will ever do much to help resolve the many torturous issues which face mankind today. On inspection I am inclined to be very negative about the "promise" of EE. Knowing that this is a most unacceptable position and totally inappropriate politically does not allow one to refuse the idea. Perhaps the greatest and saddest myth of all is that environmental education is a substantial help to the environment overall.

Summary and Comment

In this reading I have proposed the idea that a number of myths have become incorporated into the environmental education arena. Some of these may not be particularly damaging, but most certainly some of them are, especially since environmental education cannot be all things to all people.

Perhaps the greatest and saddest myth of all is that environmental education is a substantial help to the environment overall.

Among the damaging effects of the myths could be: (1) enormous confusion about what environmental education is and what it should be doing; (2) additional confusion about the makeup of a number of fields which are related to EE; (3) attempting to let students investigate and evaluate environmental issues without having the skills needed to accomplish this; (4) the development of invalid instructional programs; (5) the inappropriate assessment of curricular programs; (6) efforts to unethically impart our own values to our students; and (7) much too much reliance on science and technology for solving critically-important environmental issues.

Of course, there are exceptions to these myths - certainly! The point here, however, is that the myths tend to remain myths far too often, and they get the profession in trouble and they relay some very misleading concepts to people who trust those who communicate them.

I have been, am now and will remain an ardent supporter of environmental education. However, I reserve the right to sharply criticize the field whenever, in my opinion, it needs criticizing. Environmental educators, for the most part, seem quite unwilling to critically analyze the field and let it take its lumps when appropriate. Far too many professional environmental educators take umbrage when called upon to look at the field and themselves with magnifying lenses.

I posit that we must look at ourselves critically in order to, eventually, mature the field. It is with great sorrow that I observe that the field is so smitten with egocentrism and appallingly bad habits that almost nothing has been done in the last twenty years - nationally or internationally - to put EE on an effective North American or more certainly a global basis. If the consequences of this phenomenon were not so devastating to calculate, one might find forgiveness and wait longer for a modicum of maturity to take shape. However, we are most definitely running out of time for making a global citizenry responsible for the many environmental catastrophes that are befalling us or lie in the wings awaiting an opportune time to set themselves in motion.

We must find a way to make a global impact on education in order for there to be any hope of turning away from the road we are traveling.

There are things that we must do and things that we must not do. First and foremost, we must acknowledge that environmental education is a field of education and that it has a substantive structure just like algebra, civics, biology, or psychology. Many have argued over what environmental education is and what its structure should look like and some still do. However, this phenomenon is a meld of provincialism, ignorance, politics, and banality which gets us nowhere in advancing the field.

We must facilitate a sharply defined and articulated structure - one which meets research parameters - and stop accepting absolutely counterproductive suggestions from every Tom, Dick, and Harry who have a bone to pick with the field or, again, a political harp to play. We must stop seeing parameters written for the field that incorporate the utterances of "experts" and "commissions" without any attention being given to extant structures proposed for the field. We must also stop seeing goals and objectives written which have been taken, by and large, from other fields and which do nothing to facilitate important environmental concepts and skills for learners.

We need to stop listening to the so-called experts who feel that any field must be saturated with subject matter content before a student can be taught how to think or to folks who simply have no feel whatsoever for the research in the field and are unwilling to spend the time understanding the research so that environmental education can, indeed, meet its promise.

If challenged to encapsulate a substantive structure for environmental education, I might try, initially, to reduce it to its most major components. The capsule might read:

> *"We must teach learners, both young and old, how to use those higher order thinking skills so often called for and so equally elusive. We must also teach those same learners - yes, even youngsters - how to inquire in intellectually honest ways and how to think reflectively instead of dualistically while making those excruciatingly difficult decisions about the environment and human well being. In short, we must teach our children how to critically assess the environmental problems and issues facing them and how to rationally make those grievous decisions that are now and will continue to be so very necessary."*

These things can be done! I am sure many people are tired of hearing or reading this, but let me paraphrase once again something that Trudi Volk and I said many years ago:

> *"We know what the [educational] problems are! We have the tools needed to solve those problems at our disposal! The only thing we need to do is to begin doing things differently than we have done them in the past!"*

It is time for our fellow professionals to begin listening.

A Survey of the Status of State-Level Environmental Education in the U.S.

Michelle Kirk, Richard Wilke, and Abby Ruskey

The data for this study were collected in 1995 and 1996. Thus, the results are relatively current in terms of this book's copyright date. The purpose of this study was to obtain information about the status of comprehensive state-level environmental education programs in the United States. The researchers felt that comprehensive state-level EE programs consist of a combination of program, structure, and funding components. They found that no state currently has the 16 components of what the writers identify as a comprehensive program. Most states did have individual components, such as teacher training, EE associations or funding sources for EE. A total of 118 state EE leaders provided information on the status of EE. How these conditions have changed since the data were collected is unknown. However, based on the findings of this study, one can infer that there remains a good deal to be accomplished for EE nationwide.

Introduction

Since the time of the international *Tbilisi Declaration* (UNESCO 1978), much progress has been made in the field of environmental education (EE) in the United States. Environmental education curricula guides, inservice teacher training and nature center or outdoor field experiences for school aged youth have become common in most states. However, much of the efforts to incorporate environmental education into formal education have been piecemeal. In 1994, Ruskey and Wilke defined a model for assisting states in achieving an environmentally literate populace. This model identifies program, structure and funding components required for a comprehensive EE program. Prior to this study, no research had been conducted to identify the extent to which each of the fifty states has achieved the 16 components of a comprehensive program as identified by Ruskey and Wilke. Several studies have been undertaken in the past twenty years to assess the status of environmental education at the state level (Disinger and Bowman 1975, Disinger and Bousquet 1982, Cooper 1989, Disinger 1989, and EE Associates, Inc. 1993). However, these studies have focused on individual EE components such as teacher training, state agency support, and EE in the school curricula. The purpose of this study was to provide baseline data regarding the status of comprehensive state level EE programs in the United States. The authors hope that this information will be useful to media sources, funders, legislators, and other decision makers, as well as EE leaders working to expand and further coordinate EE programs in their states. The authors posit that nationwide environmental literacy will not be achieved until all states have the majority of components of a comprehensive EE program in place.

> **The authors posit that nationwide environmental literacy will not be achieved until all states have the majority of components of a comprehensive EE program in place.**

Methods

Questionnaire

The survey instrument, *Status of Environmental Education in the U.S.*, was developed by the National Environmental Education Advancement Project (NEEAP) staff and reviewed by 10 national EE leaders with a good grasp of state level initiatives to ensure validity. Revisions were made in the instrument based on input from validity panel

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members. The final survey consisted of four main sections. Section A focused on the 16 components of a comprehensive state level EE program as identified in the model developed by Ruskey and Wilke in their book, *Promoting Environmental Education* (component definitions can be found in the notes section at the end of this article). Section B asked for information about nonformal EE and coordination between formal and nonformal EE within the state. Contact information for nonformal EE programs was also requested. Section C asked for information about EE programs at the college and university level. Section D asked for information on key EE contacts within the state. This article focuses on the results obtained from Section A of the questionnaire.

Population

The survey was mailed to five environmental education (EE) leaders in each state (the survey did not include the District of Columbia or the territories of the United States). The five leaders included the EE specialist in the state Department of Education (or the person with EE responsibilities), the president of the state EE association, the Project Learning Tree Coordinator, the Project WILD coordinator and the National Association of Conservation Districts education contact. It was assumed that these individuals, as central contacts for EE in the state, had an overall perspective of their state's EE program. Only four surveys were sent to two states due to the fact that one person was responsible for two of the positions identified. In a few states, respondents, not falling into one of the five categories, were added who are known for their experience and leadership in working with EE. With the addition of these individuals, a total of 253 surveys were eventually distributed.

Follow-up

In September of 1995, the survey was mailed to the five contacts in each state along with a cover letter and a self addressed, stamped envelope. Survey respondents were asked to return the completed survey by November 1, 1995. To ensure as complete a response as possible, a follow-up letter and additional survey were sent out on November 17th and respondents were urged to respond as soon as possible. Additional phone calls were made to nonrespondents during December and January. As of February 9, 1996, 113 responses (45%) had been received. Responses were received from all fifty states. In cases where respondents within a state reported conflicting information, a call was made to one of the respondents and more information was gathered to resolve the conflict. The final results reflect the corrected information.

Results

There was some variation in how each state responded to the questions on the survey. In a few states, the five leaders gathered together and answered the survey as one voice. In most cases, several different surveys were received from a state, each representing an individual effort. In a few cases, only one respondent within the state returned a completed survey. Results from the completed surveys were compiled and arranged in grid formats to give a national as well as individual state perspectives on the status of state level components of a comprehensive EE program [(see Tables 1, 2, and 3)]. [These tables identify] which EE components each state has in place, as well as which components are being developed. . . .

Discussion

Program Components [(Table 1)]

(Master Plan, By-law or Requirement, Coordinated Inservice, Pre-service Requirement, Curriculum Guide, EE Learner Objectives or Outcomes, Grants Programs, and Assessment that incorporate EE concepts)

By far the most common program component is the state *EE grants program*. Intended to provide funds to increase EE programming at the grassroots level, these grants programs are reported in 21 states. State *EE Learner Objectives or Outcomes* (also known as Benchmarks, Essential Skills, etc.) are intended to assist educators in developing specific instructional plans. Of the seventeen states reporting this component, ten indicate that these objectives are included in existing or newly developed science standards (as well as within social studies, geography and general curriculum standards). While every state has *inservice* opportunities in EE for teachers, only fifteen states report that there is a coordinated system in place which makes EE training available to all teachers within a state. Seven states report that they are currently working towards coordinating the efforts of

By far the most common program component is the state *EE grants program*.

inservice providers. Within the arena of required EE instruction or teacher training, there is a smaller number of states reporting these components and fewer still actively pursuing them. One of the least common of all the components is the *preservice requirement* for teachers. Only three states reported having this component in place and at this time, only four states are developing this requirement.

Program components were reported as the greatest area of development among states. Eleven states report having a state *EE master plan* in place to guide future planning. Seven of these plans were developed in the past four years. Thirteen additional states are currently developing master plans to guide their states as they work to create comprehensive EE programs. Another area of possible growth is the *EE curriculum guide*, such as Wisconsin's *A Guide to Curriculum Planning in EE* (Engelson and Yockers 1994). These guides offer instructional strategies, resource listings and suggestions for developing curriculum. Fifteen states currently report having guides while twelve additional states report that they are in the process of developing guides (respondents may confuse this component with actual EE curriculum instructional materials or guides). The *state assessment which incorporates EE concepts*, which was only reported to be present in three states, is being developed in 10 states at this time.

Structure Components [(Table 2)]

(EE Board, EE Office, EE Center, Interagency Committee, EE Association, and Computerized Networking System)

The area with the most widespread implementation is that involving infrastructure for EE programs. *EE associations* are by far the most commonly found component, reported in 45 states. These professional grassroots organizations are often key players in developing other EE components. Notably, many states have set up the necessary boards, offices and centers to support the wide variety of EE programs that exist. In 16 states, state *EE offices* are in place with EE coordinators or specialists and support staff. At least 37 states have staff with EE responsibilities that are housed in state agencies. These offices can generally be found in the state departments of education or natural resources/environmental protection agencies. Twenty-three states have an *EE interagency committee* and 22 have an *EE advisory board or council*. Interagency committees help ensure coordination and eliminate overlap among the state agency EE providers. The advisory boards/councils typically have diverse representation statewide and provide policy direction, and implementation oversight to EE master plans. Further infrastructure support is found in 20 states in the form of EE *centers* and/or regional offices. While EE programs and training are provided in most, if not all, states by numerous nonformal outdoor and EE centers, 20 states report that they have state EE centers and/or regional offices which assist educators and administrators in the incorporation of EE. These centers provide services such as resource libraries, inservice programs and assistance for infusing EE into district and school curriculum. Additionally, a state EE center may serve as a central link for networking among teachers who are interested in EE.

The area with the most widespread implementation is that involving infrastructure for EE programs. *EE associations* are by far the most commonly found component, reported in 45 states.

Funding Components [(Table 3)]

(Funding Sources for EE and EE Trust Funds)

Twenty-four states report funding *sources* that support programs and 5 states report the presence of an *EE Trust Fund* for handling those dollars. Respondents identified several revenue sources for EE efforts such as environmental license plates, tax check-offs, lottery funds, and pollution fines.

Conclusions

Whereas no state has all 16 components in place, many states are well on their way to achieving comprehensive EE programs. Twelve states (Arizona, Arkansas, Florida, Kentucky, Maryland, Massachusetts, Minnesota, North Carolina, Pennsylvania, Virginia, Washington, and Wisconsin) report between eight and twelve components in place. At this time, there appears to be much work being done within states to develop new components. Thirty-two states are actively pursuing at least one of the components of a comprehensive program. Components such as computerized networking systems (18 states), state EE master plans (13 states), EE curriculum guides (12 states), EE Learner Objectives/ Outcomes (10 states) and state Assessments which incorporate EE concepts (10 states) were reported by numerous states as areas for growth this year. Several states, such as Illinois, Iowa, Missouri, Louisiana, North Dakota, and

Tennessee, are in the early stages of building a more comprehensive program. These states are currently pursuing a wide range of components. With successful adoption of the components being developed within each of the states, a possible twenty-three states could report eight or more components of a comprehensive program in place in the near future.

It is important to note that due to the tremendous diversity of state education programs, not all states will pursue the same initiatives or achieve them in the same manner. Many variables including: differences among school systems, community support and awareness of EE, state agency personnel support for EE, and the state's political climate all ensure that each state will find its own way towards creating a strong and effective EE program.

Recommendations

The authors recommend that this study should be repeated once every two years in order to track the status of EE at the state level. Given the pace of change in education today, some components which were being developed at the time of the study may now be in place whereas other components reported in place may have been eliminated through legislation or school policy. A repeated survey will provide a picture of how steadily comprehensive EE programs are growing in the United States. Future surveys should include definitions for each of the 16 components to ensure a consistent response from all respondents. Additionally, measures should be taken to ensure that a collective response to survey questions is provided by state EE leaders.

> **Many variables including: differences among school systems, community support and awareness of EE, state agency personnel support for EE, and the state's political climate all ensure that each state will find its own way towards creating a strong and effective EE program.**

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NOTES

Program Components - Definitions

State EE Master Plan

A comprehensive state plan whose purpose is to chart a course of action and to provide an implementation schedule for meeting state goals for EE. These plans set forth the goals and objectives for EE within the state and typically list who is best suited to achieve or implement them (e.g. the legislature, the business community, school administrators, etc.). They are created through input from a wide range of EE leaders, educators, legislators, state agency representatives, business representatives, and others.

State By-law or Requirement for K-12 EE Instruction

Requirement that schools and K - 12 teachers incorporate EE into their existing curriculum. This component is achieved through legislative or administrative avenues. Includes EE in the state's philosophy or mission statements for education as well as curriculum offerings.

Coordinated Statewide Teacher Inservice Training in EE

Teacher training that targets K - 12 teachers and enables them to become fully competent to teach to all of the goals of EE. A coordinated system of inservice programs makes EE training available to all teachers within a state and allows for professional development options in EE.

Required EE Training prior to Teacher Certification or Licensing

EE preservice training required for teachers desiring to teach certain subjects or grade levels that provides instruction in and ensures competencies in environmental/ecological concepts, the range of instructional and assessment methodologies used with EE and effective approaches for infusing or inserting EE into the curriculum.

State EE Curriculum Guide or other state publication providing direction to the development of an EE program at the school district level

EE Curriculum Guides often include instructional strategies, resource listings and suggestions for developing curriculum. They assist in integrating EE into existing curriculum and helping with curriculum/school restructuring. EE Curriculum/ Resource Guides sometimes have units and lessons for use by teachers and school districts.

EE Learner Objectives/Outcomes/ Frameworks

Objectives, Outcomes, Benchmarks, Essential Skills, etc. are intended to assist educators in developing specific instructional plans and assessment strategies for incorporating EE in given subject areas. These help ensure instructional consistency within academic disciplines among the state's schools and may be exit oriented or lesson oriented.

State Supported EE Grants Program

Grants program that uses state and/or private sector funds to enhance EE. EE grants programs are typically overseen by state offices for EE, state EE Boards or Advisory Councils and are accessible to both formal and nonformal education entities for enhancing or creating state and locally based EE projects.

State Assessment Program that Includes EE

Application of assessment "tools" (including standardized testing, authentic/ performance assessment measures and other evaluation methods) to determine the extent to which EE curriculum and instruction is having the desired impact on students.

Structure Components - Definitions

State EE Board/Advisory Council

State EE Boards or Advisory Councils are the policy making and implementation oversight bodies for many state EE programs. EE Boards/ Councils normally include key representatives of sectors/ constituencies supporting EE including school teachers and administrators, university and business representatives, legislators, state agency representatives, and leaders from nonprofit conservation organizations.

These entities often oversee implementation of an EE master plan's recommendations. Further it may also complete assessments of the status of EE statewide, continue to identify needs and set priorities for EE, consult with the Department of Education (or equivalent), Department of Natural Resources and other state agencies and offices about EE program priorities, complete regular reports to the legislature, oversee an EE grants program and solicit funds.

State EE Office

State office and staff with EE responsibilities such as the following: assess the status of environmental literacy; prepare an EE plan; staff the EE grants program; promote and assist in the development of EE learner outcomes; promote and aid in the development of EE preservice and inservice teacher training; cooperate with federal and state agencies and the private sector around EE programs; function as an EE clearinghouse; initiate, develop, implement, evaluate, and market nonformal EE programs; initiate research on EE; and coordinate EE conferences on a periodic basis.

State Level EE Centers and/or Regional Offices

EE Center(s) whose primary goal is to assist educators and administrators throughout all levels of the education system in the incorporation of EE as required or recommended by the state legislature. Typical services include: inservice EE programs, assistance in infusing

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EE into district and school curriculum, resource libraries, school networking programs, and EE literacy assessment projects.

Interagency State EE Committee

Committee of state agency representatives (sometimes include Federal agency representatives with state offices) which work to eliminate overlap in EE programs and to leverage their resources for greater impact.

State EE Association

Non-profit, professional grassroots organization whose members typically include teachers, agency and nature center professionals, college faculty and students, community educators as well as organizational members such as colleges and universities, school districts, environmental groups, businesses and county, state and federal agencies. This organization helps support and implement EE programming as well as providing members with networking opportunities, professional development and communication about EE concerns.

Computerized Networking System for EE Materials and Services

Computer network that provides educators and EE leaders with access to EE resources, events, funding opportunities and other helpful information.

Funding Components - Definitions

Funding Sources for EE

Source(s) of funding to support the state level EE program infrastructure and specific programs, such as an EE grants program. Can be provided by a variety of means such as general revenue, license plate fees, resource user fees, polluter fines, taxes, lotteries and private donations and grants.

EE Trust Fund for raising and supporting EE programs with both public and private dollars

Mechanism for generating and disbursing financial resources for EE. Trust funds are a permanent fund, enabling EE leaders to collect and spend both private (grants and donations) and/or government dollars.

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Key to Tables Which Follow:

▨ D: Components Being Developed

■ P: Components in Place

Table 1 - Comprehensive State Level Environmental Education - Program Components

	Master Plan	Bylaw/Req	Inservice	Preservice	Curr Guide	Objectives	Grants Pg	Assessment
Alabama			■		▨	■	■	▨
Alaska								
Arizona	■			■		■	■	
Arkansas	■	■	■		■	■	■	▨
California		■▨			■▨	▨	▨	
Colorado	■					■		
Conn ct	▨		■		▨		■	
Delaware			■	■		■		
Florida					▨	▨	■	
Georgia	▨	■	■	▨	▨		■	
Hawaii	▨		■		■	■		
Idaho								
Illinois	▨	■	▨	▨		▨	▨	
Iowa		■	▨				■	▨
Kansas					■			■
Kentucky	■▨						■▨	
Louisiana	▨	■			■▨	▨	▨	▨
Maine					▨	▨		
Maryland		■	■			■	■	■
Mass.	■▨		▨			■	■▨	▨
Michigan								
Minnesota	■	▨	■	▨	■	■▨	■	▨
Miss.								
Missouri			▨			■▨		
Montana								
Nebraska			■				■	
Nevada		■			■▨			
N.Hamp.								■
New Jersey	■					■		▨
N. Mexico	▨							
New York					■			
N. Carolina	■		■▨				■	
N. Dakota	▨							
Ohio		■			■	■	■	
Oklahoma			■				■	
Oregon								
Penn.	■	■			▨	▨	■	▨
Rhode Is.					▨	▨	■	
S. Carolina					■		■	
S. Dakota								
Tennessee	▨		▨		▨	■		
Texas			■					
Utah								
Vermont	▨					▨		
Virginia			■		■▨	■	■	▨
Wash.	■	■	▨	▨	■	■		▨
W.Virginia	■				■	■		
Wisconsin	▨	■	▨	■	■		■	
Wyoming					■	■		
	11P/13D	12P/2D	15P/7D	3P/4D	15P/12D	17P/10D	21P/4D	3P/10D

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Table 2 - Comprehensive State Level Environmental Education - Structure Components

	EE Board	EE Office	EE Center	Inter. Comm.	Association	Computer
Alabama	▨			■	■	▨
Alaska					■	
Arizona	■		■		■	■
Arkansas	■	■	■	■	■	
California	■	■		■	▨	▨
Colorado	▨	■			■	▨
Connecticut	▨	■	■ ▨	■	■	▨
Delaware	■	■	■			
Florida	■	■	■	■	■	■
Georgia	■				■	
Hawaii				■	■	■ ▨
Idaho					■	
Illinois			▨	■	■	▨
Indiana	▨	▨	▨	■	■	▨
Iowa	▨	■	▨	▨	■	▨
Kansas	■				■	
Kentucky	■	■	■	■	■	■
Louisiana		▨		■	■	
Maine				■	■	▨
Maryland	■		■		■	
Massachusetts	■	■	■	■	■	■ ▨
Michigan	▨				■	
Minnesota	■	▨		■	■	▨
Mississippi			■			
Missouri	▨			▨	▨	
Montana					■	
Nebraska					■	
Nevada					■	
N. Hampshire			■		■	
New Jersey	■	■	■	▨	■	▨
New Mexico	■				■	
New York		■	■		■	
N. Carolina	■	■	■	■	■	■
North Dakota				▨		▨
Ohio					■	■
Oklahoma	■	■		■	■	▨
Oregon	■		■		■	
Pennsylvania	■	■	■	■	■	▨
Rhode Island			■		■	▨
S. Carolina	■			■	■	
S. Dakota					■	
Tennessee	▨	■		■	■	
Texas	■		■	■	■	■
Utah			■ ▨		■	■ ▨
Vermont				■	■	
Virginia				■	■	■
Washington	■	■	■	■	■	■
West Virginia	■				■	
Wisconsin	■		■	■	■	▨
Wyoming					■	
Totals	22P/8D	16P/3D	20P/5D	23P/4D	**45P/2D**	11P/18D

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Table 3 - Comprehensive State Level Environmental Education - Funding Components

State	Funding Sources	Trust Fund
Alabama	■	
Alaska		
Arizona	■	
Arkansas	■	
California	■	▨
Colorado	■	
Connecticut	■	
Delaware		
Florida	■	■
Georgia		
Hawaii	■	
Idaho		
Illinois	▨	
Indiana	■	
Iowa	■	▨
Kansas		
Kentucky	■	■
Louisiana	▨	▨
Maine		
Maryland	■	■
Massachusetts	■	■
Michigan		
Minnesota	■	
Mississippi		
Missouri	■	
Montana	■	
Nebraska		
Nevada		
New Hampshire		
New Jersey	▨	
New Mexico		
New York		
North Carolina	■	▨
North Dakota	▨	
Ohio	■	
Oklahoma		
Oregon	■	
Pennsylvania	■	
Rhode Island		
South Carolina	■	
South Dakota		
Tennessee		
Texas		■
Utah		
Vermont		
Virginia	■	
Washington	■	
West Virginia		
Wisconsin	■	
Wyoming	▨	
Totals	24 in place - 5 under development	5 in place - 4 under development

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Education Reform, Setting Standards, and Environmental Education

Deborah Simmons

This article was written for this book of readings at the request of the editors. The topic of "standards" is so very important to the field of environmental education that it needs to be thoroughly discussed in a book of this kind. In this piece, Dr. Simmons discusses, among other things, the need for standards, the origin of standards, and the relation that should exist between standards and an overriding goal of environmental literacy.

Standards, accountability, assessment, transdiscipliniary learning, and systemic change, each describes one of the many building blocks of education reform. Although the development of standards is only one of the pieces, it has garnered much public attention and scrutiny.

The calls for standards setting were first heralded with the publication, in 1983, of *A Nation at Risk*. Pointing to declining test scores, poorly prepared high school graduates, declining enrollment in science and mathematics, low academic achievement in comparison to many European and Japanese students, and low levels of literacy, significant questions concerning the quality of the American educational system were raised. Following the publication of *A Nation at Risk*, it became common to call into question the very structure of American education.

A decade long move toward national education reform received its highest level of governmental recognition with the passage and signing of the Goals 2000: Educate America Act in 1994. The Educate America Act set out eight broad, national goals for the year 2000. Although each of the eight goals, if fully realized, could substantially change education, two of the goals have received the greatest public attention. Goal #3: Student Achievement and Citizenship states that, "by the year 2000, American students will leave grades four, eight, and twelve having demonstrated competency in challenging subject matter, including English, mathematics, science, history, and geography; and every school in America will ensure that all students learn to use their minds well, so they may be prepared for responsible citizenship, further learning, and productive employment in our modern economy." Goal #4: Science and Mathematics states that "by the year 2000, U.S. students will be first in the world in science and mathematics achievement."

These goals set a national mandate to establish high standards for the core disciplines. Although voluntary, these national standards have been designed to provide state and local education leaders guidance in the development of academic outcomes.

Each of the core curriculum areas (e.g., science, geography, mathematics, English - language arts, history, civics) has developed a set of voluntary national standards. These standards delineate the knowledge and skill bases of their respective fields. They are designed to define what students should know and be able to do in order to be considered geographically literate, scientifically literate, mathematically literate, etc.

Although obviously written to address the needs of specific discipline based areas, these standards do, to one degree or another, address environmental education interests. Taken singly, the standards of any one discipline allow for environmental learnings. For example, essential ecological knowledge such as the components of Earth's physical systems: the atmosphere, lithosphere, hydrosphere, and biosphere; how Earth-Sun relations affect conditions on Earth; and the physical characteristics of places (e.g. landforms, bodies of water, soil, vegetation, and weather and climate) are included within *Geography for Life: National Geography Standards* (1994). Similarly, understandings of measurement, patterns and relationships, and statistics and probability, all elements of *Curriculum Evaluation Standards for School Mathematics*

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(1989) are also important for environmental literacy.

Conversely, environmental education programs can be used to meet discipline-based standards. Because environmental education is by its very nature interdisciplinary, it can help students meet the high standards set by the traditional school disciplines (e.g., science, mathematics, geography, history). The ability of environmental education programs to further these disciplinary standards is illustrated in materials developed by the World Resources Institute. Students participating in the unit on Sustainable Development (Paden, 1994), for example, will not only gain understandings essential to environmental education, but will gain understandings related to the standards set by the *National Standards for Civics and Government* (1994) (e.g., What are the roles of the citizen in the American political system?), *Geography Standards* (1994) (e.g., physical systems, human systems, environment and society), *Curriculum and Evaluation Standards for School Mathematics* (1989) (e.g., mathematics as problem solving, statistics), and *National Science Education Standards* (1996) (e.g. science as inquiry, life science, science and societal challenges).

Integrated throughout the curriculum, environmental education also has the potential of furthering the general education reform agenda. Conley (1993) argues that education reform must address the past failure to teach process skills which "led to the inevitable fragmentation of knowledge into 'infobits,' and to graduates who appeared unable to apply much of what they had learned to real-world situations." Environmental education with its focus on developing a well-informed, responsible citizenry "has potential as an exemplary vehicle for what many believe all of education should consider its primary function: furthering the development of higher-order skills - critical thinking, creative thinking, integrative thinking, problem solving." (Disinger, 1993).

Although environmental education can effectively and efficiently facilitate the learning of specific concepts and process skills, it also provides an often missed opportunity for synthesis of material that crosses disciplinary boundaries, connecting learnings to create a whole. Thus, environmental education can help to address a commonly held criticism of schooling:

> The curriculum is treated as a collection of discrete content areas in which teachers move from one topic to another in lockstep fashion. As a result, lessons are often developed in isolation from one another and fail to help students relate their new learnings to what they already know. (Applebee, Langer, and Mullis 1989 in Conley).

Perhaps the explicit focus of environmental education on the integration of knowledge and skills is one of the primary distinguishing factors between it and a traditional view *of* curricular disciplines. Because environmental education is, by its very nature, interdisciplinary, the synthesis of learnings across subject material is a deliberate and essential outcome. Disinger (1993) suggests:

> An implicit assumption of disciplinary philosophies is that students will be able to perform their own synthesis when it becomes necessary to do so, by drawing as needed on their learnings from separate content areas. But rarely do students receive instruction or engage in guided practice in developing syntheses and drawing generalizations ... Environmental education can provide a convenient and challenging mechanism for overcoming the shortcomings of monodisciplinary education, by using the interdisciplinary entity that is the environment as a focus for teaching and learning.

The strengths of environmental education can be effectively used as a way of meeting education reform goals. Well constructed environmental education programs are learner-centered, providing students with opportunities to construct their own understandings through hands-on, minds-on investigations. Learners are engaged in direct experiences and are challenged to use higher-order thinking skills.

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Environmental education is essential education. Environmental education is a field unto its own . . ..

Environmental education supports the development of an active learning community where learners share ideas, expertise, and prompt continued inquiry. Environmental education provides a pedagogy that promotes systems thinking, while studies of the environment can provide real-world contexts and issues from which concepts and skills can be learned. Finally, environmental education has the potential of linking the K-12 curriculum, providing the opportunity to meet the requirements of the core disciplines by creating a comprehensive and cohesive program of study.

The Need for Environmental Literacy

But it must be emphasized that environmental education is more than a useful theme that can tie units of learning together or an effective pedagogy that makes learning more meaningful. Environmental education is essential education. Environmental education is a field unto its own and enjoys a rich history. Its philosophical and pedagogical heritage can be traced to Aristotle and Rousseau, to Dewey and the progressive schools movement, to nature study, conservation education and outdoor education. John Disinger (1993), writing on the history of environmental education, describes its evolution:

> It is generally accepted that the impetus for the synthesis leading to environmental education in the late 1960s was increased concern for environmental quality - fear of severe deterioration of human health and quality of human life - caused by dramatic declines in environmental quality. Thus, the rationale for initiating today's environmental education was, in effect, to refine and redirect the goals of its predecessors as well as to fill an educational vacuum not being served: attention to the interactive interrelationships between humans and their environments.

Further, he states that:

> . . . since the 1970s, environmental education has also been characterized by the development of explicit and implicit interconnections with human health, science, and technology, and the environmental, economic, and social issues and problems of society.

In the last three decades there has been much progress made toward addressing environmental concerns that confront the United States and the world as a whole. In the U.S. alone, there have been legislative initiatives such as the passage of the Clean Water Act, Endangered Species Act, National Environmental Protection Act and the National Environmental Education Act. Communities throughout the nation have instituted comprehensive integrative solid waste management programs, and individuals participate in roadside clean-up, watershed protection, community gardening, habitat restoration, environmental monitoring, and stewardship programs.

But the celebration of successes must be tempered by the magnitude of the environmental issues that continue to lay before us. Globally, environmental degradation impacts quality of life. Whether issues of water quality, loss of species diversification, or urbanization are considered, the unfortunate truth is that environmental concerns are more often addressed in isolation, as just one more item on a very long list of needs.

Alternatively, David Orr (1992) argues that environmental quality:

> . . . is not only a permanent feature on the public agenda; for all practical purposes it is *the* agenda. No other issue of politics, economics, and public policy will remain unaffected by the crisis of resources, population, climate change, species extinction, acid rain, deforestation, ozone depletion, and soil loss.

For us to address these environmental problems and prevent new ones, we need an environmentally literate citizenry that is not only capable of taking individual action, but of making well-informed public policy decisions collectively. Increasingly, individuals are asked to make choices on complex issues that affect their own lives, the lives of their families, their communities, and the world beyond their shores. Choices are made every time people enter a store, turn on a water faucet, plant a butterfly garden, or set the thermostat in their homes. Each time citizens vote, they make environmental decisions. When public policy is made on international trade agreements such as NAFTA and GATT, these decisions not only impact the economy and jobs, but the environment.

If it can and should be argued that environmental literacy is an important goal for our society, then certainly it can and should be argued that environmental education must play an integral role throughout our educational system - - at the national level, at the state level, and in each and every classroom.

Environmental literacy is predicated on the belief that if we educate our citizens so they are capable of making quality decisions, they will do so when the time comes. But this assumes that we are educating children to be able to take their places as environmentally literate citizens. To educate these children effectively, it also assumes that those who teach the children are themselves environmentally literate and knowledgeable about how to teach environmental education.

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According to a recent survey of pre-service teacher education programs in the United States, Rosalyn McKeown-Ice (1995) found that only 13% of secondary education majors and 14% of elementary education majors were required to take a course in environmental education as part of their pre-service program. Given the lack of pre-service teacher education in environmental education, it is not too surprising that studies completed in both Wisconsin (Lane, Wilke, Champeau, and Sivek 1994) and Illinois (Smith-Sebasto and Smith 1994) found that few teachers feel well-prepared to teach environmental education in their classrooms.

Furthermore, assessments of the environmental literacy of school-aged children have, for the most part, found poor levels of overall performance. A study of fifth grade and eleventh grade students in Wisconsin concluded that ". . . relative to environmental literacy . . . students demonstrate positive attitudes and predictors of behavior." However, the students' actual behaviors are limited and their knowledge is marginal (Champeau et al. 1996). Similarly, the pilot test results of the *Middle School Environmental Literacy Instrument* (Bluhm et al. 1995) indicated that students in the sixth, seventh, and eighth grades did poorly on all ten of the literacy variables. With the exception of one of the variables, Ecological Foundations, " . . . students did not even achieve 50% of criterion. These data would seem to allow one to infer that students are not receiving substantial EE curricula in the schools participating in this study." (Bluhm et al. 1995).

Although we are accomplishing a great deal with environmental education in this country, and there are literally thousands upon thousands of success stories, it is obvious that we have not yet reached a point where students leave our educational system environmentally literate. Volk and McBeth (draft, 1997) examined the results of 38 environmental education research studies. Although the studies varied widely in terms of variables, audiences, and outcomes, the authors did find a pattern of positive results related to the use of specific instructional strategies: community investigations, citizenship participation, and participation in environmental studies/management courses. According to the findings of the report, participation in community investigations and citizenship action:

> . . . appeared to have a positive impact an attitudes, socio-political knowledge, environmental issue knowledge, cognitive skill development, and both responsible environmental behavior and several determinants of responsible environmental behavior. Similarly, an environmental studies course and an environmental management course appeared to positively impact those same variables, when those courses were taught with ample discussion of environmental issues and with the goal of increasing empowerment toward environmentally responsible behavior.

Volk and McBeth go on to suggest that:

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> . . . all of the studies in these two areas utilized instruction which was sustained over time, which appeared to be thoughtfully and logically sequenced, and which actively sought to develop understandings, intellectual skills, and social participation in learners. In almost all of these studies, the focus (both instructional and research-wise) was not on a single component within environmental literacy, but rather on multiple components.

If excellence in environmental education is our goal, it must be consciously and diligently built.

Toward a Coherent Framework for Environmental Education

Any discussion of the foundations of environmental education must acknowledge the significant contributions of the authors of the Belgrade Charter (UNESCO/UNEP, 1976) and the Tbilisi Declaration (UNESCO/UNEP, 1978). These two documents furnished an internationally accepted blueprint for environmental education. The Belgrade Charter, adopted at the first UNESCO/ UNEP sponsored workshop on environmental education, set forth a goal for environmental education, and as such, provides a broadly endorsed vision statement which has been widely used as a guidepost:

> The goal of environmental education is to develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations, and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones.

The Tbilisi Declaration (UNESCO/UNEP, 1978), adopted by acclamation at the world's first intergovernmental conference on environmental education, further delineated a set of goals for environmental education:

> To foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural areas;
>
> To provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment;
>
> To create new patterns of behavior of individuals, groups and society as a whole towards the environment.

Additionally, the Tbilisi Declaration outlined five categories of objectives for environmental education:

> Awareness - to help social groups and individuals acquire an awareness and sensitivity to the total environment and its allied problems.
>
> Knowledge - to help social groups and individuals gain a variety of experiences in, and acquire a basic understanding of, the environment and its associated problems.
>
> Attitudes - to help social groups and individuals acquire a set of values and feelings of concern for the environment and the motivation for actively participating in environmental improvement and protection.
>
> Skills - to help social groups and individuals acquire the skills for identifying and solving environmental problems.
>
> Participation - to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward the resolution of environmental problems.

Much of the work in environmental education has followed the path outlined by the Belgrade Charter, the Tbilisi Declaration, and later in Agenda 21 (UNCED, 1992). With the evolution of the field, these principles have been researched, critiqued, revisited, and expanded. Over the years, scholars such as Hungerford et al. (1980), Iozzi et al. (1990), Roth (1992), the Wisconsin Center for Environmental Education (1992), and the Environmental Education Literacy Consortium (1994) have examined what it means to be environmentally literate, and each has proposed a framework or definitional structure.

In 1977, the Tbilisi Declaration proposed five categories of objectives for environmental education: awareness, knowledge, attitudes, skills and participation. Although the language has changed over time and categories have been combined and split apart, there is a great deal of overlap between the Tbilisi objectives and the various goals presented in the subsequent environmental education literature. Hungerford et al. (1980) explicitly validated four goal levels against the Tbilisi objectives:

GOAL LEVEL I: The Ecological Foundations Level

GOAL LEVEL II: The Conceptual Awareness Level

GOAL LEVEL III: The Investigation and Evaluation Level

GOAL LEVEL IV: The Issue Resolution Skills Level

Of particular interest is that the four goals provide greater detail, distinguishing among different types of knowledge. For example, Goal Level I states that students should be able to apply major ecological concepts (e.g., species populations, energy production and transfer, succession), apply the knowledge of these ecological concepts to an analysis of environmental issues, predict the consequences of proposed solutions to environmental issues using their knowledge of ecological concepts, and locate and use scientific information as they further investigate environmental issues.

Building on this work, Iozzi et al. (1990) not only include awareness and attitude components (affect), knowledge (cognitive domain), and participation (responsible environmental behavior), but proposed two additional components: locus of control (i.e. "... individual's sense that he or she can manifest some influence upon or control over the outcomes of a specific activity") and assumption of personal responsibility. Similarly, Roth (1993) divides his framework into four strands: knowledge, affect, skill and behavior. Although included under the affect strand, Roth also recognizes the importance of both locus of control and the assumption of personal responsibility in his model.

The work presented by the Wisconsin Center for Environmental Education (1992) continues in a similar vane, proposing four major outcomes: cognitive (knowledge of ecological principles, knowledge of environmental problems and issues, knowledge of environmental issue investigation and action strategies), affective (environmental sensitivity/awareness), determinants of environmentally responsible behavior (locus of control and assumption of personal responsibility) and environmentally responsible behaviors. It should be noted that knowledge of environmental issue investigation and action strategies has been placed within the cognitive outcome category. This component of knowledge is included under a skills category in some of the other models.

Finally, the work of the Environmental Education Literacy Consortium (1994) synthesized much of this literature, forming four categories: cognitive dimensions (knowledge and skills), affective dimensions, additional determinants of environmentally responsible behavior (i.e., students "believe in their ability, both individually and collectively, to influence outcomes of environmental problems and issues" and "assumption of responsibility for personal actions that influence the environment"), and personal and/or group involvement in environmentally responsible behaviors. Of particular interest is the recognition of the importance of the socio-political domain (along with ecological knowledge) as foundational to the cognitive dimensions. Although the socio-political domain is imbedded in several of the frameworks, the Environmental Education Literacy Consortium has elevated it to an equal status of ecological knowledge.

Toward Coherence

Although these frameworks differ in the specifics of the categorization of elements, there are substantial areas of agreement. Based substantially on these works, a framework for environmental education was proposed as an initial step in the development of national environmental education learner guidelines (Simmons, 1995). As part of the National Project for Excellence in Environmental Education, initiated by the North American Association for Environmental Education, this framework suggested seven key components of a comprehensive environmental education program: affect, ecological knowledge, socio-political knowledge, knowledge of environmental issues, cognitive skills, additional determinants of environmentally responsible behavior, and environmentally responsible behavior. The framework has been reviewed by over 2500 individuals and organizations. Based on these reviews, the framework is being drafted into a set of guidelines that will describe what environmentally literate learners should know and be able to do by the time they graduate from high school. Setting these expectations provides the scaffolding upon which cohesive, sequential, comprehensive environmental education programs can be created.

Environmental education has a well developed philosophy, set of goals and objectives, and framework that address essential educational, societal, and ecological issues. But the development of environmental education standards recognizes that to be truly effective, environmental education must be consciously integrated into the curriculum. A commitment to integration throughout the school curriculum has been one of the central tenants of environmental education (Tanner, 1974; Hungerford, 1975; Stapp, 1978; Simmons, 1989; Disinger, 1993).

Environmental education has a well developed philosophy, set of goals and objectives, and framework that address essential educational, societal, and ecological issues.

The commitment to integration is built upon the understanding that environmental issues cut across traditional disciplinary lines and that developing an environmentally literate citizenry involves knowledge, attitudes, and skills beyond that of a simple understanding of scientific or ecological principles. Tilbury (1995) argues that environmental education is:

> . . . based on the premise that environmental and development problems are not solely caused by physical and biological factors, but that an understanding of the parts played by aesthetics, social, economic, political, historical and cultural elements is required.

She goes on to assert that:

> . . . the investigation of any environmental issue must involve the study of the intersection and interaction of these elements. This focus within environmental work recognizes that only such an approach will capture the interdependent and multifaceted nature of the environmental situation.

By taking a holistic approach to the teaching of environmental education, synergy among its basic "parts" can and must be created. As students analyze and evaluate the complexities of an environmental issue they begin to understand the intricacies of the connections that they could not have discovered if the information was presented fact by fact and subject by subject outside of the context of the environment as a whole. However, only the development of a comprehensive environmental education program insures that it will not be marginalized or fragmented. "Environmental education" that is simply dropped into the curriculum as an interesting activity to do on a Friday afternoon is not environmental education, and will not promote environmental literacy. To be effective, environmental education programs must be constructed and cannot be left to chance.

Students need a comprehensive program that encompasses the full range of knowledge, skills, and inclinations that are essential to foster environmental literacy. Environmental education standards will provide the teacher with needed guidance to ensure the development of a coherent, sequenced program of study.

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In endorsing the need for environmental education standards, the President's Council For Sustainable Development, also provides some very practical reasons for their development:

> Currently, educators at the state and district levels *are* struggling to define new statewide learning standards based on the voluntary national standards certified under the Goals 2000 program. Educators have called for a set of essential learnings in environmental education that could be integrated into these standards. Funders of environmental and global education projects also have expressed a need for a set of peer-reviewed, widely agreed-upon learning standards that could guide them in assessing programs. Additionally, many states have adopted mandates to teach environmental education. However, without a generally accepted framework of skills and concepts, these mandates can be difficult to implement and evaluate.

A set of standards not only provides educators in general, and the field of environmental education specifically, with an understanding of the knowledge and skills that lead to environmental literacy, but a vision of environmental education's place within the school curriculum.

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Environmental Literacy in the United States

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Editors' Notes: This document was originally written as a white paper at the request of The Environmental Education and Training Partnership in 1996 with funding provided by the US Environmental Protection Agency. Its purpose was to explore the concept and status of environmental literacy as it applies to education within the United States. Further, it was to make specific recommendations concerning environmental literacy and how it might be measured across US learner populations in the future.

The White Paper does not appear here in its entirety due to its length. Instead, the editors have abridged it severely, printing those portions that seem to be critical to such a reading. Because of this, a detailed description of the research related to literacy does not appear here, although the findings of the authors are summarized and discussed. This abridgment of the White Paper may have compromised the document to some extent, and we recommend to those who wish to see the entire document to obtain it from the North American Association for Environmental Education.

This paper explores environmental literacy in the United States. The document grew from the perception of a need for a national assessment of the environmental literacy of US students. Such an assessment could be used in the collection of normative data that would help the field of environmental education establish baseline information regarding environmental literacy. Subsequent national literacy assessments could also provide information, over time, so that the field of environmental education could evaluate its progress and make decisions related to future directions.

In exploring the feasibility of a national assessment of environmental literacy, we first examine where scholars, educators, and researchers believe the field of environmental education should be (the aims and goals of environmental education). We then attempt to determine the current state of environmental literacy through a review of research which has focused on various aspects of environmental literacy. A comparison between "what should be" (the ideal described in the aims and goals of the field) and "what is" (the current status of environmental education as revealed in its research) identifies gaps or weaknesses between the ideal and the actual. A subsequent section presents recent environmental education research literature on the effectiveness of instruction in addressing various literacy components. Recommendations are then offered, both in respect to environmental literacy and in respect to directions for research. Thus, this report [in its entirety - not complete here] contains the following sections:

- The Desired State Of Environmental Literacy: What Should Be.
- The Current State Of Environmental Literacy: What Is.
- A Discrepancy Analysis: A Critical Comparison.
- The Research Literature: Getting From What Is To What Should Be.
- Recommendations.

The Desired State Of Environmental Literacy: What Should Be.

[Editors Note: In operationalizing the desired state of environmental literacy (what should be), the authors used the framework for environmental education developed by NAAEE's National project for Excellence in Environmental Education.]

The framework developed by the NAAEE National Project for Excellence in Environmental Education included seven categories: affect, ecological knowledge, socio-political knowledge, knowledge of environmental issues, skills, additional

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determinants of environmentally responsible behavior, and environmentally responsible behaviors. Descriptions of these categories, adapted from Simmons (1994), are presented below.

Affect refers to factors within individuals which allow them to reflect on environmental problems/issues at the intrapersonal level and to act on them if they judge the issue/problem warrants action.

Ecological Knowledge refers to the knowledge of major ecological concepts. Ecological knowledge also refers to a knowledge and understanding of how natural systems work, as well as a knowledge and understanding of how natural systems interface with social systems.

Socio-political Knowledge includes an understanding of the relationship between beliefs, political systems, and environmental values of various cultures. Socio-political knowledge also includes an understanding of how human cultural activities (e.g., religious, economic, political, social and other) influence the environment from an ecological perspective. Also included within this category is knowledge related to citizen participation in issue resolution.

Knowledge of Environmental Issues includes an understanding of environmental problems and issues caused as the result of human interaction with the environment. Also included within this category is knowledge related to alternative solutions to issues.

Cognitive Skills are those abilities required to analyze, synthesize, and evaluate information about environmental problems/issues and to evaluate a select problem/issue on the basis of evidence and personal values. This category also includes those abilities necessary for selecting appropriate action strategies, and for creating, evaluating, and implementing an action plan.

Additional Determinants of Environmentally Responsible Behavior include locus of control and the assumption of personal responsibility.

Environmentally Responsible Behaviors include active and considered participation aimed at solving problems and resolving issues. Categories of environmentally responsible actions are persuasion, consumer action, ecomanagement, political action, and legal action.

The Current State Of Environmental Literacy: What Is.

Summary of Findings

If we are to summarize the findings at this point, it would appear that the field of environmental education is far from accomplishing its major goal of environmental literacy. In all cases, the overall measure of literacy ranges from low to moderate. Based on a review of research studies, the overall assessment summary suggests that the affective dimensions of environmental literacy are at a moderate level, ecological and socio-political knowledge are low, and both environmental issue knowledge and environmentally responsible behavior tend to be low. No inferences can be forwarded relative to either the cognitive skills or the additional determinants related to environmentally responsible behavior.

Discussion of Findings

Probably the most obvious observation to be made from [an analysis of the research] is that the research is unevenly distributed across the environmental literacy components. The bulk of the research has focused on variables related to affect and environmental issues knowledge. Less than half of the studies reviewed measured environmentally responsible behavior, ecological knowledge, or socio-political knowledge. And no studies were found which resulted in a discrete measure of cognitive skills related to environmental literacy or of additional determinants of environmentally responsible behavior. It must be noted, however, that the identification of these components of a literacy framework is a relatively recent event and that the research reported here has been ongoing since the late seventies. Thus, the environmental literacy model was not in existence to guide the research.

> **The bulk of the research has focused on variables related to affect and environmental issues knowledge. Less than half of the studies reviewed measured environmentally responsible behavior, ecological knowledge, or socio-political knowledge.**

As we more closely examine the research related to the seven literacy components, it also becomes apparent that researchers were not assessing the similar aspects of any one variable. This is especially obvious in the case of the research studies which addressed the affective dimension. Here, researchers sought to ascertain levels of a number of variables within affect. Within that variable, researchers sought to collect measures of general affect (e.g., an environmental world view, environmental concern, attitudes toward the environment, support toward the environment/acceptance of social responsibility), and of more specific attitudes (attitudes toward animals, concern about agricultural issues, opinions concerning Great Lakes issues, concern about selected environmental issues, attitudes toward oil/gas development at a state forest, and the priority given to teaching water topics). That disparity between the affective variables which were assessed affords little potential to compare results across studies, or to collapse the results into a meaningful summary statement to report on the status of the affective component of environmental literacy. Similar situations of disparity between what was measured can be observed relative to almost all of the literacy components.

The disparity between variables is directly linked to a diversity of instrumentation used in the research. In many research studies, the researchers elect to generate their own instruments instead of utilizing existing instrumentation. Two problems arise from this practice. The first problem revisits the inability to compare results due to the differing nature of what is measured and how it is measured. The second problem relates to the lack of validity and reliability of these instruments, which weakens the strength of the research and of its findings. Only 53%, or slightly more than half of the studies reviewed here, reported a measure of validity. An even smaller portion, 40%, reported a reliability estimate.

The research has used samples from a variety of locations. Samples represented a total of seventeen states, with five of the study sites unspecified (14%). Thirty-four percent (34%) of the study sites were located in the northeastern United States, and 31% included midwestern samples. The remainder of the studies (20%) used samples from the northwest, southwest, west and southeast. Interestingly, four states (Kentucky, New York, Ohio, and Virginia) reflect almost 43% of the samples included in the research. Thus, several regions of the US are under-represented in the current knowledge base on environmental literacy, while others are over-represented. In a similar fashion, numerous individual states are either under-represented or simply not represented at all. Because of this, we simply cannot present a meaningful statement regarding the status of any one of the literacy components in the United States. Any attempt to summarize the results of existing research reflects diverse elements within the environmental literacy components and within disparate localities across the United States.

Instructional Effectiveness: Getting From "What Is" to "What Should Be ".

A summary of studies which assessed the effectiveness of educational programs on influencing components of environmental literacy is presented in the table which follows. These studies set out to assess instructional effectiveness using some type of instrumentation which measured one or more components of environmental literacy. It is important to note that these studies did not quantify the level of literacy, per se. Rather, they reported their findings on a comparison basis.

A number of these studies made comparisons between groups of students who experienced different instructional treatments. Other studies made comparisons within a single group of students on a pretest and posttest basis. However, all of these studies sought to determine the impact of instructional treatment on one or more literacy components. Thus, these studies will provide us with an indication of whether the environmental literacy components can be positively influenced thorough instructional programs.

A Selection of Studies Which Assessed Instructional Effectiveness Concerning Aspects of Environmental Literacy

Study	Validity/ Reliability	Independent Variable	Subject Grade/Age	Dependent Variable	Significant Effect
Adams et al., 1987	No/No	Biology course	High School	Attitude	+
Armstrong & Impara, 1991	Yes/Yes	Supplemental instruction	5, 7	Attitude, Ecological Knowledge	- Mixed
Bennet, 1982	Yes/Yes	Social studies program	Junior high school	Socio-Political Knowledge	+
Benton, 1993	No/Yes	Environmental management course	College	Attitude, Environmental Issue Knowledge, Additional Determinants, Responsible Behavior	+ + + +
Birch & Schwaab, 1983	Yes/Yes	Instructional unit	7	Attitude, Environmental Issue Knowledge	+ +
Brothers et al. , 1991	Yes/No	Television documentary	Adults	Attitude Environmental Issue Knowledge	+ +
Burrus-Bammel & Bammel, 1986	Yes/Yes	Residential camp	16 - 20 years	Attitude Ecological Knowledge	+ +
Collins et al., 1978	No/Yes	Field trip with activities	4,5,6	Attitude	+
Crater & Mears, 1981	No/No	Instructional unit	8	Attitude, Environmental Issue Knowledge	+ +
Dresner, 1989/90	No/No	Simulation game	College	Attitude, Additional Determinants	- -
Dunlop, 1979	Yes/Yes	Simulator	Teachers	Attitude	-
Fortner & Lahm, 1990	Yes/Yes	Instruction (in-classroom information and site visit)	4, 5	Attitude, Ecological Knowledge	- +
Fortner & Lyon, 1985	Yes/No	Television documentary	Adults	Attitude, Ecological Knowledge	+ +
Geller, 1981	No/No	Workshop	Adults	Attitude, Additional Determinants, Responsible Behavior	+ + -
Glass, 1981	No/Yes	Workshop	Teachers	Attitude, Environmental Issue Knowledge	+ +
Jaus, 1982	No/Yes	Instruction	5	Attitude	+
Jaus, 1984	Yes/Yes	Instruction	3	Attitude	+
Jordan, et al., 1986	Yes/No	Residential camp	High School	Socio-Political Knowledge, Responsible Behavior	+ +
Kidd et al., 1978	No/No	Forest camp	16-20 years	Attitude, Ecological Knowledge	+ +
Kinsey & Wheatley, 1984	No/No	Environmental studies course	College	Attitude	Mixed
Lawrenz, 1985	No/Yes	Workshop	Teachers	Attitude	-
Marshdoyle et al., 1982	No/No	Field trip	4, 5, 6	Ecological Knowledge	+
Mills et al., 1985	Yes/Yes	Computer simulation	Teachers	Attitude, Environmental Issue Knowledge	- +

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Table continued: A Selection of Studies Which Assessed Instructional Effectiveness Concerning Aspects of Environmental Literacy

Study	Validity/ Reliability	Independent Variable	Subject Grade/Age	Dependent Variable	Significant Effect
Milton et al, 1995	No/Yes	Park/school program	5	Attitude, Ecological Knowledge	- +
Pomerantz, 1986	Yes/No	Children's nature magazine	5	Ecological Knowledge	+
Ramsey & Hungerford, 1989	Yes/Yes	Instruction (investigation and action)	7	Attitude, Socio-Political Knowledge, Cognitive Skills, Additional Determinants, Responsible Behavior	- + + +
Ramsey, 1993	Yes/Yes	Instruction (investigation and action)	8	Attitude, Socio-Political Knowledge, Cognitive Skills, Additional Determinants, Responsible Behavior	- + + Mixed +
Ramsey et al., 1981	No/No	Instruction (investigation and action)	8	Socio-Political Knowledge, Responsible Behavior	+ +
Ross & Driver, 1986	No/No	Youth Conservation Corps program	15 -18 years	Attitude, Environmental Issue Knowledge, Responsible Behavior	+ + +
Shepard & Speelman, 1985/86	No/No	Outdoor education program	9-14 years	Attitude	-
Simmons, 1984	No/No	Presentation methods (on-site vs. simulated visit)	Adults	Attitude, Environmental Issue Knowledge	+ +
Smith-Sebasto, 1995	Yes/Yes	Environmental studies course	College	Socio-Political Knowledge, Cognitive Skills, Additional Determinants, Responsible Behavior	+ + + +
Stapp et al., 1983	No/No	Middle school curriculum	6, 7	Attitude, Environmental Issue Knowledge, Cognitive Skills Additional Determinants	+ + + +
Strickland et al. 1983/84	Yes/Yes	Instruction	3-5 years	Environmental Issue Knowledge	+
Trent, 1978	No/Yes	Workshop	Teachers	Attitude, Environmental Issue Knowledge	- +
Volk & Hungerford, 1981	No/Yes	Instruction	8	Environmental Issue Knowledge, Cognitive Skills	+ +
Westphal & Halverson, 1985/86	No/No	Workshop	Adults	Environmental Issue Knowledge, Responsible Behavior	+ +
Wilson & Tomera, 1980	Yes/Yes	Supplemental case study	High school	Attitude	-

In the research literature which focused on instructional effects and the environmental literacy components, the most frequently measured variables were attitudinal in nature, with 76% of the studies focusing on some aspect of affect. The second most frequently studied variable was environmental issue knowledge, representing 34% of the studies. In descending order according to the frequency of study, 24% of the studies included responsible environmental behavior as a dependent variable, and 21% of the studies incorporated a measure of ecological knowledge. Measures of additional determinants of environmentally responsible behavior were included in 18% of the studies,

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socio-political knowledge in 16% of the studies, and cognitive skills in 13% of the studies. The findings within each of the literacy components are further described below.

- Twenty-nine of the studies measured aspects of the affective dimension. The measure of affective variables, however, led to the most inconclusive and least positive outcomes. Of those twenty-nine studies, fourteen (48%) reported positive changes, eleven (38%) reported no significant changes, and four (14%) reported mixed or questionable results.

- Thirteen of the studies included environmental issue knowledge as a dependent variable. Of these studies, eleven (85%) reported positive impacts and two (15%) reported no significant changes.

- Nine studies included a measure of responsible environmental behavior. Seven studies (78%) reported positive changes, one (11%) reported no significant changes, and one (11%) indicated questionable results.

- Eight studies attempted to ascertain changes in ecological knowledge. Seven studies (87.5%) reported positive changes and one study (12.5%) reported no significant change.

- Seven studies incorporated additional determinants of responsible environmental behavior as a dependent variable. Of these, five (71%) reported positive impacts and two (29%) reported mixed or questionable results.

- Six studies measured aspects of socio-political knowledge. All (100%) reported positive changes in this variable as a result of instructional intervention.

- Five of the studies included cognitive skills as a dependent variable. Again, all of these studies (100%) reported positive impacts of instruction.

Thus, positive changes in attitude were observed in 48% of the studies which measured that variable. Of the knowledge components, 100% of the studies which included socio-political knowledge resulted in positive measures, 87.5% of the studies measuring ecological knowledge yielded positive results, and 85% of those which included a measure of environmental issue knowledge reported favorable changes. Positive changes in cognitive skills were observed in 100% of the studies where these variables were included and 71% of the studies which measured additional determinants of responsible environmental behavior reported positive outcomes. Lastly, when responsible environmental behavior was measured as an outcome of instruction, the impacts were positive in 78% of the instances.

Discussion of Research Findings

One implication of the above findings is that environmental education efforts, as represented by the studies described here, appear to be most successful when they address the development of cognitive skills (intellectual process skills) and socio-political understandings. Attempts to increase ecological and environmental issue knowledge also tend to result in favorable outcomes, as does fostering responsible environmental behavior and its determinants. Relative lack of success has been met by efforts to increase affective (attitudinal) dimensions of environmental literacy.

We must be cautious in these interpretations, however, since we are limited by the categories of instructional intervention which were studied and by the instruments which were used to measure the outcomes of instruction. No measure of instrument validity was reported in 55% of the studies, and no reliability measures were reported in 45% of the studies. Moreover, the studies were almost equally divided among those which reported measures of BOTH validity and reliability (34%), those which reported measures of NEITHER validity or reliability (34%), and those which reported measures of one, but not the other (32%). Clearly, there is a need for the use of valid and reliable measures as we continue research and evaluation within environmental education.

If we leave the question of instrumentation and examine the results of these studies, however, an interesting picture emerges regarding the relative effectiveness of techniques. The most promising areas of instruction appear to be in community investigations and citizenship participation and in environmental studies/ management courses. The instruction in the former area included Hungerford's Issue Investigation and Action Training model (IIAT) and Stapp's Action Research and Community Problem Solving model (AR&CPS). This group of studies appeared to have a positive impact on attitudes, socio-political knowledge, environmental issue knowledge, cognitive skill development, and both responsible environmental behavior and several determinants of responsible environmental behavior.

> **We must be cautious in these interpretations, however, since we are limited by the categories of instructional intervention which were studied and by the instruments which were used to measure the outcomes of instruction. No measure of instrument validity was reported in 55% of the studies, and no reliability measures were reported in 45% of the studies. . . . Clearly, there is a need for the use of valid and reliable measures as we continue research and evaluation within environmental education.**

Similarly, an environmental studies course and an environmental management course appeared to positively impact those same variables, when those courses were taught with ample discussion of environmental issues and with the goal of increasing empowerment toward environmentally responsible behavior. It is also worthy of note that all of the studies in these two areas utilized instruction which was sustained over time, which appeared to be thoughtfully and logically sequenced, and which actively sought to develop understandings, intellectual skills, and social participation in learners. In almost all of these studies, the focus (both instructional and research-wise) was not on a single component within environmental literacy, but rather on multiple components.

Studies on the viewing of a television documentary are consistent in their findings, with positive results in both attitudinal and knowledge dimensions (ecological and environmental issue knowledge). Both studies which focused on the media measured knowledge and attitudes associated with a specific area of issues. Thus, using this form of media appears to be useful and effective when promoting the acquisition of knowledge and concern. Residential camp programs also appear to have positive impacts on a several of the literacy variables. Two of the camp program studies measured and reported favorable changes in attitudes and ecological knowledge. Two measured and reported favorable changes in socio-political knowledge, environmental issue knowledge and responsible environmental behavior.

Less consistency was observed in the other areas of instruction which served as independent variables in these studies. Several studies incorporated traditional courses with environmental content, instructional units, and field trips and other out-of classroom activities as treatment variables. Dependent variables were attitudinal and knowledge variables (ecological knowledge, socio-political, or environmental issue knowledge). A majority of the findings of these studies were significant. However, there were also several reports of non-significant, mixed, or questionable results.

The two areas of instruction which appear to be the least effective of this group of studies are workshops and supplemental instruction in the classroom. In both of these areas, the frequency of nonsignificant and mixed or questionable results equals or exceeds the frequency of significant results. In many of these studies, it appeared that the treatment may have been short term and might be considered episodic, although it was often difficult to determine the exact nature of the instruction. In many cases, we also cannot determine how the "instructional event" (the independent variable) related to the ongoing instructional program. Unless an instructional event is part of a logically developed, well articulated program, the learner may have difficulty in assimilating its meaning.

In other words, if an instructional event is a "stand alone" activity (that is, not connected to ongoing instruction), then it would appear likely that it would also stand alone in the mind of the learner, rather than become integrated into his or her working knowledge of the world. This reinforces the importance of planned and logically sequenced instruction in which each instructional element connects to the other elements and contributes to the whole.

What does this mean to the practitioner? In this section, we have looked to the research literature to answer whether or not components of environmental literacy can be positively impacted by instruction and the answer is most decidedly "yes", with an important *caveat*. That caveat is that the instruction must be logically developed and meaningfully sequenced, and it must be focused on multiple components of environmental literacy. Rather than focusing on the development of environmental knowledge *or* the development of favorable attitudes toward the environment *or* the development of environmental actions, we should use instructional models and methods which encourage the development of the whole environmentally responsible individual . . . knowledgeable and thinking individuals who enter willingly into decision making and problem solving arenas in their personal lives and in society at large. We can not teach scientific and ecological concepts in isolation and simply expect the learner to see societal implications. Neither can we teach socio-political understandings and expect the learner to automatically apply them to environmental problems and issues. And we most decidedly cannot teach environmental actions without the concurrent development of information accessing and processing skills and without the analytical and evaluative dimensions of decision making.

It is interesting to note that nine studies (24%) measured attitude as the single dependent variable (or outcome of instruction). Thirteen (34%) measured attitude in conjunction with either ecological or environmental issue knowledge. Thus, 58% of the studies focused solely on attitudes and knowledge. Presumably, this reflects a strong emphasis in instruction on attitudes and knowledge. While acknowledging that the attitude and knowledge components of environmental literacy are very important, we would suggest that this focus is too narrow. Research into responsible behavior indicates a much more complex relationship which incorporates attitudes, knowledge, cognitive skills and psychological characteristics. This relationship suggests that it would appear more productive in our society to teach for informed and capable decision makers, who possess the knowledge to foresee consequences of current practices and behaviors from both scientific and societal perspectives, who have the skills to weigh and evaluate the desirability of those consequences, and who embrace the opportunity to actively and responsibly participate as citizens.

Lastly, it would be a boon to the field of environmental education to establish, on a wide scale basis, where we are in our level of literacy. Our knowledge is based on a patchwork of individual studies which, for the most part, measured single or double variables using a variety of different instruments. Although we have called into question the instruments by which many of these variables have been measured, valid and reliable instruments appear to be in existence, and could be employed in an endeavor to obtain a national profile of environmental literacy among various age groups and/or constituencies. With that, we would have a much better understanding at the level of environmental literacy within the population. Knowing that, and knowing where we want to be, we can ascertain the success of our efforts over time by periodically assessing environmental literacy in our society.

Recommendations.

A number of recommendations arise from this [literacy] review. Several of those recommendations result from the research findings related to environmental literacy. Others relate to the nature of the research which has been undertaken and reported. Still others relate in a general way to environmental education.

1. We appear to know little about the actual *status* of environmental literacy within the United States. The studies which were reviewed have focused predominantly on affective attributes and on environmental issue knowledge. Little attention has been afforded to measuring levels of environmentally responsible behaviors. Still less has focused on ecological knowledge, socio-political knowledge or on additional determinants of environmentally responsible behavior. The cognitive skill component remains conspicuously absent in the assessments of environmental literacy, although many argue for the inclusion of problem solving and decision making skills as an integral part of environmental education. Thus, we recommend that a holistic assessment of environmental literacy be undertaken which includes measures of all components of literacy. In this way, we would hope to obtain a more comprehensive picture of environmental literacy among those measured.

2. Contributing further to the incomplete picture of the status of environmental literacy are sampling concerns. The studies here include samples which, taken as a whole, can in no way be considered as representative of the United States. In all probability, the nature of the sampling results from lack of funding to undertake a nationwide assessment. Thus researchers often resorted to using a sample of individuals from a population which was convenient to them. If we desire to gain a nationwide perspective of environmental literacy, then we must include within our research a carefully chosen nation-wide sample of individuals.

Thus, we recommend a national literacy assessment, or series of assessments. Such a series of assessments should include individuals representative of a variety of geographic areas and other demographic factors. The series might be initiated with a study of school age populations (elementary/middle school, secondary school, college/university), and then proceed to the general public. We recommend that the school age population be initially assessed, since acquiring random samples and administering the instrument(s) will probably be more easily accomplished with the school age population than with the adult population.

3. Although the studies in this review attempted to quantify measures of literacy components (e.g., a high level of environmental concern; a low level of environmental issue knowledge), such a discrete measure may well be suspect. It is probable that few of the instruments were constructed in such a way to provide a definitive measure. For example, does a score of 100% on a ten item survey of environmental issue knowledge indicate that an individual is completely knowledgeable? . . . Does a score of 50% indicate that a second individual knows half as much as the first?

It can be argued that *we simply do not have definitive measures of a number of variables*, and that relative measures would be more pertinent. That is to say, *it seems imperative to establish a baseline measure of the literacy components from several populations so that comparisons might be made between populations and over time.*

Similarly, it would be helpful to use population assessments to provide normative data. These data could reveal how individuals within populations compare to others within that population. Thus, we recommend an initial baseline assessment of environmental literacy to provide normative information for specific populations. Subsequent assessments, undertaken at intervals, could then reveal how those literacy measures change over time within populations. We also recommend that these assessments be repeated at regular intervals in order to provide a description of environmental literacy over time. Such assessment could furnish important information to educational planners regarding their instructional efforts.

4. It is also recommended that existing instrumentation be utilized where possible. For example, a recent project focused on the development of instruments to assess environmental literacy at the middle school, high school and preservice levels (Wilke, 1995). This project was funded by the US Environmental Protection Agency through the National Consortium for Environmental Education Training (NCEET). The instruments developed for this project were consistent with the NAAEE environmental literacy components. In addition, validity and reliability estimates were established for the middle school and secondary school instruments, and they were piloted in five school districts. Further research has been conducted using the middle school instrument. The preservice instrument is currently under further development and testing.

Note: Once again we remind the reader that this document was abridged to a great extent. However, the editors have chosen to print the List of References in its entirety so that the reader may see the extent to which the literature was searched in the preparation of the entire document.

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Goals for Curriculum Development in Environmental Education

Harold Hungerford, R. Ben Peyton, and Richard J. Wilke

In this reading, the authors take a hard look at the field of environmental education and synthesize a set of goal statements for curriculum development in the field. Using the Tbilisi Declaration as a basis for establishing a substantive structure for EE, Drs. Hungerford, Peyton, and Wilke determined that goals for the field could be placed in four rather hierarchical goal levels: (I) An Ecological Foundations Level; (2) A Conceptual Awareness of Issues and Values Level; (3) An Issue Investigation and Evaluation Level; and (4) An Environmental Action Skills Level. Although this article appeared in the Spring 1980 edition of *The Journal of Environmental Education*, the goals continue to receive a good deal of attention by professionals who want to develop materials based on a sound scope and sequence of content and activities.

Environmental education (EE) has made numerous advances along a number of fronts over the past decade. The state-of-the-art with respect to the development of goals for curriculum development, however, has largely remained stable with a few notable exceptions including Harvey, Stapp, and the Tbilisi Intergovernmental Conference (4, 11, 12). Further, there exists no research providing a comprehensive description of EE program(s) or project curricula developed and implemented in the nation's elementary and secondary schools (3). This lack of knowledge results in curriculum development which is largely intuitive in nature without a cohesive strategy to guide developers toward goals which would facilitate the production of a citizenry competent to cope successfully with environmental issues.

The writers believe that the responsibilities of environmental education are too great . . .the time is too short . . .and practitioners' skills too few to allow curriculum development to remain a matter of intuition. Environmental educators must learn from the mistakes made by conservation educators, or as Hobart stated,

> *lacking a coordinated, comprehensive, and uniform base, environmental education too will grind to a halt, axle deep in the same stuff that buried conservation education, for the failures of conservation education were rooted in the lack of its foundation (5).*

Concern about this lack of foundation for environmental education was expressed as early as 1970 by Clay Schoenfeld, then editor of *The Journal of Environmental Education* . Schoenfeld noted at the time that environmental education was at a stage of development which was passed long ago by many other areas of study, i.e., there is no clearly defined and delineated substantive structure for environmental education. In preparation for the 1975 Belgrade International Workshop on Environmental Education fourteen state-of-the-art papers were prepared by recognized authorities. In one of these papers, *The Nature and Philosophy of Environmental Education: Some Fundamental Goals, Concepts, Objectives and Developmental Issues*, Schmieder pointed out that "although some problems are widely apparent, some general goals clear, there is still little consensus as to what the domain of environmental education is, (or) what an environmental educator should know or do." (Endnote 1) Schmeider's premise is supported by Childress, Harvey, and by a review of the literature pertaining to curriculum and program development in environmental education conducted by Roth (3, 4, 8). Subsequent to his review, Roth reported that "the presence of environmental education in public school curricula can often be characterized by loose organization and little sense of direction."

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... goals are needed to provide a sense of direction for curriculum development and instruction

It is generally agreed by curriculum specialists that, irrespective of the subject, goals are needed to provide a sense of direction for curriculum development and instruction (9). Vande Visse and Stapp have expressed the need for goals in environmental education (13). They have warned that " . . . without a clear statement of goals, an environmental education program would become a series of unrelated experiences, focusing on limited program objectives." Unfortunately, this warning appears to have gone unheeded by numerous environmental education programs and projects, for Childress found in his survey of 301 environmental education programs and projects (3) that less than 40 percent of the programs and projects surveyed considered the following objectives to be primary objectives:

- Synthesizing various alternative solutions to environmental problems into a comprehensive plan.
- Analyzing the role of contributing factors (technology, legislation, etc.) to the causes of environmental problems.
- Evaluating how varying value systems modify and shape the environment.
- Developing proficiency in environmental data collecting techniques.

Childress concluded from his study that:

> *. . . objectives focused on helping students become knowledgeable about their environment and its associated problems, and developing an appreciation of environmental resources, were considered of more importance in a majority of programs and projects than were those objectives focused on helping students actually solve environmental problems and develop problem solving skills.*

The lack of emphasis upon objectives which focused on helping students actually solve environmental problems and develop problem solving skills is contrary to the recommendations for environmental education objectives contained in both the 1975 Belgrade Charter and in the 1977 Tbilisi Intergovernmental Conference Report.

The apparent inconsistency between the objectives expressed for and used in EE programs and projects and those recommended by documents such as the Belgrade Charter and the Tbilisi Declaration may be due, in part, to the inherent difficulties confronting a curriculum developer charged with the task of translating what are actually general goals (e.g., to develop environmental awareness, knowledge, attitudes, skills, etc.) into manageable instructional objectives. The difficulties inherent in translating the general goals into instructional objectives have, as Childress has noted (3), resulted in the use of "hunches" as a basis for curriculum planning.

It is the opinion of the writers that curriculum developers and practitioners need a set of intermediate or subgoals which are more definitive than the general goals usually described for EE. This opinion is consistent with Krathwohl's proposal that a three-tier hierarchy be used for educational objectives (7). Krathwohl's proposed hierarchy consists of 1) general goals, 2) intermediate or subgoals, and 3) instructional objectives.

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Additional support for the need for subgoals for EE came from the Teacher/Leadership Education Working Group during the 1978 National Conference on Environmental Education. Charged with the responsibility of aiding in the development of a national strategy for EE, this working group expressed the need for subgoals which could be used in curriculum planning. To meet this need the Group recommended that the original *Goals for Curriculum Development in Environmental Education* (Hungerford, Peyton and Wilke, 1978) be revised as needed, validated, and used to meet the need for subgoals for curriculum development. (Endnote 2)

It is, therefore, the intent of this article to present 1) the Goals for Curriculum Development in Education, 2) the assumptions made in developing the goals, 3) the developer's validity comparison between the goals and the Tbilisi objectives for EE, and 4) the results of a subsequent validity assessment by a panel of five nationally recognized environmental educators.

Goals for Curriculum Development in Environmental Education (Endnote 3)

The Superordinate Goal **:** . . .to aid citizens in becoming environmentally knowledgeable and, above all, skilled and dedicated citizens who are willing to work, individually and collectively, toward achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment. (Endnote 4)

Level I. Ecological Foundations Level

This [goal] level seeks to provide the receiver with sufficient ecological foundations knowledge to permit him/her to eventually make ecologically sound decisions with respect to environmental issues.

The Ecological Foundations Level would minimally include the following conceptual components:

A. Individuals and populations.
B. Interactions and interdependence.
C. Environmental influences and limiting factors.
D. Energy flow and materials cycling (biogeochemical cycling).
E. The community and ecosystem concepts.
F. Homeostasis.
G. Succession.
H. Man as an ecosystem component.
I. The ecological implications of man's activities and his communities.

Level II. Conceptual Awareness Level - Issues and Values

This [goal] level seeks to guide the development of a conceptual awareness of how individual and collective actions may influence the relationship between quality of life and the quality of the environment and, also, how these actions result in environmental issues which must be resolved through investigation, evaluation, values clarification, decision making, and finally, citizenship action.

Goals at this level are formulated to provide opportunities for receivers to conceptualize:

A. how man's cultural activities (e.g., religious, economic, political, social, etc.) influence the environment from an ecological perspective.
B. how individual behaviors impact on the environment from an ecological perspective.
C. a wide variety of environmental issues and the ecological and cultural implications of these issues.
D. the viable alternative solutions available for remediating discrete environmental issues and the ecological and cultural implications of these alternative solutions.
E. the need for environmental issue investigation and evaluation as a prerequisite to sound decision making.
F. the roles played by differing human values in environmental issues and the need for personal values clarification as an integral part of environmental decision making.
G. the need for responsible citizenship action (e.g., persuasion., consumerism, legal action, political action, ecomanagement) in the remediation of environmental issues.

Level III. Investigation and Evaluation Level

This [goal] level provides for the development of the knowledge and skills necessary to permit receivers to investigate environmental issues and evaluate alternative solutions for remediating these issues. Similarly, values are clarified with respect to these issues and alternative solutions. Goals at this level are presented in two components.

Component A: Goals for Component A are to develop in receivers:

A. the knowledge and skills needed to identify and investigate issues (using both primary and secondary sources of information) and to synthesize the data gathered.
B. the ability to analyze environmental issues and the associated value perspectives with respect to their ecological and cultural implications.
C. the ability to identify alternative solutions for discrete issues and the value perspectives associated with these solutions.
D. the ability to autonomously evaluate alternative solutions and associated value perspectives for discrete environmental issues with respect to their cultural and ecological implications
E. the ability to identify and clarify their own value positions related to discrete environmental issues and their associated solutions.
F. the ability to evaluate, clarify, and change their own values positions in light of new information.

Component B: Goals for Component B are to provide receivers with opportunities to:

G. participate in environmental issue investigation and evaluation.
H. participate in the valuing process in a manner as to permit the receiver to evaluate the extent to which his/her values are consistent with the superordinate goal of achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment.

Level IV. Environmental Action Skills Level - Training and Application

This [goal] level seeks to guide the development of those skills necessary for receivers to take positive environmental action for the purpose of achieving and/or maintaining a dynamic equilibrium between quality of life and the quality of the environment. Goals at this level are presented in two components.

Component A: The goal for Component A is to develop in receivers:

A. those skills which will permit them to effectively work toward ends which are consistent with their values and take either individual or group action when appropriate, i.e., persuasion, consumerism, political action, legal action, or ecomanagement.

Component B: The goals for Component B are to provide receivers with opportunities to:

B. make decisions concerning environmental action strategies to be used with respect to particular environmental issues.
C. apply environmental action skills to specific issues, i.e., to take citizen action on one or more issues.
D. evaluate the actions taken with respect to their influence on achieving and/or maintaining a dynamic equilibrium between quality of life and the quality of the environment.

Assumptions Made By the Developers

The following assumptions have been made relative to the goals:

1. That the goals for curriculum development in EE are appropriate for use in guiding both formal and nonformal EE curriculum development efforts.

2. That a "receiver" can be thought of as any person, of any age, who can be reached through either the formal or nonformal educational sectors.

3. That the superordinate goal is philosophically correct as stated. That this goal represents the most appropriate direction for environmental education if EE is going to meet the tremendous challenges facing mankind both today and tomorrow.

4. That ecological foundations are critical to any EE program as prerequisite or corequisite cognitive knowledge. That ecological concepts are an integral part of EE. Despite this premise, it remains cogent to make certain that receivers distinguish between environmental education and ecology per se.

5. That, regardless of the importance of methodologies such as outdoor education, environmental interpretation, acclimatization, and outdoor recreation, these are not a part of the substantive structure of EE per se. Therefore, ancillary goals representing these activities directly do not appear here although a number of the goals for curriculum development in EE might be facilitated by the use of these and other methodologies.

6. That some level of "environmental sensitivity" is probably critical to the receiver's being willing and/or able to engage profitably in Levels II, II, and IV of this set of goals. Irrespective of this assumed prerequisite, the developers have arbitrarily omitted goals dealing with sensitivity on several grounds. These are:

A. Sensitivity would have to be represented as foundational.

B. Sensitivity per se cannot be operationalized in a manner as to provide for any measurable criterion level of affect.

C. Every individual will enter the EE process with a unique set of affective predispositions, generated by the individual's own background of experiences.

D. Like values clarification, sensitivity will, in part, result from EE activities themselves. In particular, judiciously developed instructional programs in ecological foundations and conceptual awareness should measurably assist in the sensitization process.

7. The process of valuing, values clarification, and moral reasoning are implicit in the goals, particularly Levels III and IV.

8. That environmental action is, in fact, represented by the five categories of action as stated in the goals (or in combinations of these categories). The assumption is also made that these action categories (or combinations of them) are exhaustive.

9. That the concept of maintaining and/or achieving a dynamic equilibrium (homeostasis) must be interpreted from both cultural and ecological perspectives. That said equilibrium may well result in a distinct compromise between quality of life on one hand and quality of the environment on the other. The curriculum developer must be constantly aware of this in order to produce curricular materials that look rationally at both the cultural and ecological costs involved in achieving a true equilibrium.

10. That the phrase " . . .to provide receivers with opportunities to apply environmental action skills to specific issues" implies no more than what is stated. That an educator cannot ethically force a receiver to take action but, instead, should provide mechanisms whereby action can be taken if desired.

11. That instructional objectives would be generated under each subordinate goal during curriculum development.

12. That EE is an interdisciplinary pursuit and that numerous disciplines must be reflected in the generation of any set of goals for curriculum development. Only in this manner can EE help receivers to successfully meet the challenges facing them as world citizens.

Developers' Initial Content Validity Assessment

Representatives at the 1977 Tbilisi Intergovernmental Conference on Environmental Education developed a set of objectives for EE ranging from an awareness level to a citizen participation level. These objectives follow:

AWARENESS: to help social groups and individuals acquire an awareness and sensitivity to the total environment and its allied problems.

KNOWLEDGE: to help social groups and individuals gain a variety of experiences in, and acquire a basic understanding of, the environment and its associated problems.

ATTITUDES: to help social groups and individuals acquire a set of values and feelings of concern for the environment and motivation for actively participating in environmental improvement and protection.

SKILLS: to help social groups and individuals acquire skills for identifying and solving environmental problems.

PARTICIPATION: to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems.

In an effort to initially assess the content validity of the goals, the researchers decided to compare the goals expressed at each level to the five categories of environmental education objectives proposed at the Tbilisi Conference. To make this comparison, the researchers independently analyzed each goal, identifying where an interface existed with the Tbilisi objective statements. Following this individual assessment, the researchers met together to synthesize the individual analyses. Table 1 represents the results of this assessment. It appears as though the goals for curriculum development bear a marked correspondence to the Tbilisi objectives. Therefore, the researchers infer a substantial degree of content validity for the goals as written.

Results of the Validity Panel Assessment

Subsequent to the developers initial content validity assessment, they submitted the goals to a validity panel consisting of seven nationally recognized environmental educators for their evaluation. The use of such a validity panel is an accepted and recommended means of establishing content validity (1, 6). Further, this same procedure is recommended by Saylor and Alexander (9) for defining and validating subgoals such as those included in the *Goals for Curriculum Development in Environmental Education.* A more complete description of the validity panel assessment follows.

During the winter of 1978 the authors developed an instrument to assess the validity of the goals. The developed instrument was sent with a copy of 1) the goals, 2) the assumptions, and 3) the developers' initial validity assessment to a panel consisting of seven prominent environmental educators. The instrument contained a number of categories to which the panelists were asked to respond. In an attempt to standardize the validity assessment, the developers requested the panelists to initially assume the superordinate goal to be conceptually correct as stated. The developers asked the panelists to make this initial assessment so that they would analyze the subordinate goals in the context of the superordinate goal. However, this did not mean that the panelists were also asked specifically to assess the superordinate goal. In additional directions given to the panelists, the developers asked them to assume that the four levels of goals were not necessarily exhaustive or appropriate as classified in the document. The developers also pointed out that it was entirely possible that they could have failed to recognize a critical element that should have "level status" in the model. The validity panelists were asked to respond specifically to the following items:

1. Content Validity - Subordinate Goals: To what extent do you perceive that the subordinate goals in this model represent the substantive structure of the superordinate goal as stated?

2. Content Validity - Superordinate Goal: To what extent do you perceive that the superordinate goal is valid for use in curriculum development in environmental education?

3. Syntax: (A) To what extent is the sequencing from Level I through Level IV logical? That is, is the "level hierarchy" appropriate? (B) To what extent is there logical sequencing within each level?

4. Subjective Analysis: To what extent do you believe that this model represents a suitable framework for curriculum development in EE?

5. Recommended Goals and/or Levels: Are there other goals and/or levels perceived as critical?

Completed validity assessments were received from five of the seven panelists. In general, the comments received from the panelists were consistent. This consistency of the comments greatly facilitated the process of revising both the goals and the assumptions made by the developers regarding the goals. The revision process was completed during the spring of 1978. The revised goals and the assumptions regarding the goals are presented in this article.

Table I

Developers' Validity Assessment: Comparison of the Goals for Curriculum Development in Environmental Education with the Tbilisi Conference Categories of Objectives

Tbilisi Objectives					Developers' Curriculum Goals	
						Goals by Level
Awareness	Knowledge	Attitudes	Skills	Particoipation		
1	2	3	4	5		
					Level I	Ecological Foundations Level All Subcomponents:
x	x				-------------------	
					Level II	Conceptual Awareness Level Subcomponents:
x	x				-------------------	A
x	x				-------------------	B
x	x				-------------------	C
x	x				-------------------	D
x	x	x			-------------------	E
x	x	x			-------------------	F
x	x	x			-------------------	G
1	2	3	4	5	Level III	Investigation and Evaluation Level - Subcomponents:
x	x		x		-------------------	A
x	x		x		-------------------	B
x	x		x		-------------------	C
x	x		x		-------------------	D
x		x	x		-------------------	E
x	x	x	x		-------------------	F
x	x	x	x	x	-------------------	G
x		x			-------------------	H
					Level IV	Action Skills Level Subcomponents:
			x		-------------------	A
			x	x	-------------------	B
				x	-------------------	C
				x	-------------------	D

Conclusions and Recommendations

Subsequent to analyzing the results of the two validity assessments, the writers concluded that the revised Goals for Curriculum Development in Environmental Education constitute a valid, syntactically sound, suitable framework for use in guiding curriculum development in environmental education.

It is therefore recommended that the Goals for Curriculum Development in Environmental Education be used as a basis for guiding curriculum development in environmental education. Further, it is recommended that instructional objectives be generated under each subordinate goal during curriculum development. Finally, it is recommended that any efforts to achieve these goals for environmental education be undertaken in a manner that is consistent with the Guiding Principles for EE proposed at the Tbilisi Intergovernmental Conference on Environmental Education (12).

. . . The Goals for Curriculum Development in Environmental Education constitute a valid, syntactically sound, suitable framework for use in guiding curriculum development in environmental education.

Endnotes

1. A.A. Schmeider, The Nature And Philosophy of Environmental Education: Some Fundamental Goals, Concepts, Objectives, And Developmental Issues. Draft of a paper for UNESCO Environmental Education Conference, Belgrade, Yugoslavia, October 1975.

2. L. Fleming, Recommendations pertaining to a national strategy for environmental education made by the Teacher/Leadership Education Working Group during the National Conference on Environmental Education, Washington, D.C., March 1978.

3. This document represents the final draft of the goals subsequent to validation. The final validity assessment was conducted by a panel of five professional environmental educators. This panel was composed of Drs. Robert S. Cook, John Disinger, Robert George, Harold McKenna, and R. Thomas Tanner.

4. Adapted from Gary D. Harvey, "A Conceptualization of Environmental Education." In J.L. Aldrich, A.M. Blackburn, and G.A. Abel (Eds.), *A Report On The North American Regional Seminar On Environmental Education* (Columbus: SMEAC Information Reference Center, 1977).

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> *By the time learners leave the primary school they should be very sophisticated in their knowledge of ecology, have a large reservoir of information concerning environmental problems and issues, be able to critically analyze issues, be able to thoroughly investigate and evaluate environmental issues, and be able to develop and apply strategies for helping to resolve those same issues.*
>
> T. L. Volk & H. R. Hungerford, 1991

Curriculum Development in Environmental Education for the Primary School[*]: Challenges and Responsibilities

Harold R. Hungerford & Trudi L. Volk

In this paper, Drs. Hungerford and Volk present a number of findings and ideas important to the curriculum development arena: (1) they identify problems which have often resulted in the development of curricula that might not be sound; (2) they list guidelines that they feel must be followed when developing an effective environmental education curriculum; (3) they present a set of goals which can be used for curriculum development if the developers want to produce responsible citizenship behavior; and (4) they list and discuss a number of critical components that must be observed in a completed curriculum which focuses on environmentally responsible behavior.

Preface: A Fictional Vignette Based on a Responsible EE Program

The following vignette represents a fictional student's view of what environmental education meant to him or her.

My education in the primary and secondary schools helped me get a very real environmental commitment. By this I mean I am committed to living my life in a way that helps solve environmental problems instead of causing them. Although I don't remember the exact sequence of events that led to this, I can tell you some of the influences that led to this decision.

Perhaps the most important result of my schooling was a sense of responsibility toward the environment. I'm referring to a responsibility which considers man's relationships with the environment, and which acknowledges the rights of other species to survive, which in reality is an attitude which respects the living systems. This way of thinking isn't necessarily human-centered, but it sure means a lot for humans over the long haul. I feel as though there can be no real quality of life for me or my children unless there is a similar quality of the environment.

As I look back over my school years, I am convinced that my teachers were, themselves, committed to the environment. Some, in particular, acted as wonderful role models for us. These teachers helped us become increasingly sensitive to the environment and concerned about it. What did they do as role models? Well, first of all, they lived an environmental ethic. Most were not radicals in the strict sense of the term, but it was obvious that they had thought about their personal lifestyles in an environmental context. And, they were willing to talk with us about their values. This helped us a great deal. In addition, they suggested books about the environment to read and places to go and things to do out-of-doors. Some of them even planned summer programs for us. Our village was not near a nature center or anything like that, so we had to get those kinds of experiences through our school or with our families.

What else? Let's see. Oh yes, many times our classes were held outside. I don't mean that the teachers just turned us loose! It was more like we needed the out-of-doors to complete what we learned in the primary classroom. An example is when we learned about food chains and food webs. I can still remember visiting different ecosystems to observe the animals and

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[*] In this paper the "primary school" refers to grades K-6.

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plants there and to try to identify the energy exchanges taking place. My favorite was the pond. I waded in up to my knees and collected all kinds of plants and animals. Of course the forest was pretty interesting too. I guess the important thing was that our teachers really made those ecological concepts come alive for us. Not only did we learn about those concepts, but we also learned how they were important to understanding environmental problems and issues.

Much of our environmental instruction was issue-oriented. It seemed as though we were constantly looking at environmentally-related issues. Sometimes our entire class would work on a single issue, and look at it from all possible angles. We examined the positions which people might take on that issue, the values associated with those positions, what these people believed that led them to those positions and values, and what the alternative solutions were for that issue. When we evaluated the possible solutions, we always looked at the social, economic, and legal consequences. And of course, we never took our eyes off the ecological consequences of the issue and of its possible solutions. That must be the bottom line when we are looking for solutions, mustn't it?

Sometimes, instead of looking at a single specific issue, we were given the opportunity to choose issues of concern to us as individuals and investigate these issues by ourselves or in small groups. This gave every student an opportunity to take an in-depth look at issues of concern to him or her. And not only did we learn from our own individual investigations, but we also learned from every other student in the class. The important thing about these individual investigations, however, was that we had to be taught the investigation skills first. Easier said than done! But, in the end we all profited immensely from this training because we also applied some of these skills in our other classes. We became rather adept at getting information from agencies, finding sources in the library, writing questionnaires, interpreting data, and the like. Most importantly, we were encouraged to take a close look at our own community and region, to investigate problems and issues close to home, and to make recommendations on how to solve those issues. That gave us a chance to use our community as our "laboratory". And, we really began to see how important each citizen could be in helping to make his or her environment a better place.

Of course, as young citizens, we needed a firm foundation in citizenship action skills. I started to develop those skills way back in the primary school. And, I got more and more sophisticated with them as I progressed through the secondary school. Interestingly enough, I was never forced to apply those skills to solving a particular environmental issue, but most of us got involved in one way or another eventually. Knowing what could be done and having practiced the skills in a school setting did a great deal to build confidence in our ability to bring about changes in the real world. Because we got involved in some important local issues, we felt like we were really participating citizens and not just spectators on the sidelines. It's funny, but most of us are still involved in helping to improve the environment in our communities.

Anyway, it's hard to identify one thing and one thing alone, and say that it is the reason I am environmentally responsible today. All of the things I have talked about here are important. In the final analysis though, it is probably a matter of perspective, a point of view. I believe that I am responsible for the environment. I believe each of us has that responsibility. After all, the environment is our life support system, right? And we do need to take care of it - for our own sake!

Those are the things I learned in my schooling. Those are the things which probably made me the kind of a person I am today.

Introduction

Environmental education varies widely from community to community and from region to region. It is probably quite rare that an individual could report the kind of school experiences described above by our fictional student. And yet, a number of sources seem to indicate that an effective environmental education program should have a number of those characteristics evident in the vignette.

Why is a sound environmental education curriculum so elusive? The cause might very well lie in the problems associated with curriculum development, in general, as well as with the development of environmental education curricula. What are some of those problems and how might they be resolved?

> **The curriculum should be constructed, at least in part, in the context of the local school, the region and its resources, and the issues involved!**

In this paper, we will attempt to address the following: (1) we will identify problems which have often resulted in poor curricula; (2) we will list the guidelines that we feel must be followed when developing an effective environmental education curriculum; (3) we will present a set of goals which can be used for curriculum development if the developers want to produce responsible environmental behavior; and (4) we will list and discuss a number of critical components that must be observed in a completed curriculum which focuses on environmentally responsible behavior.

However, before we begin, there is something we must communicate. We can identify problems associated with curriculum development, establish professional challenges, identify guidelines and goals, and list critical components that one must observe in a completed curriculum. However, it is difficult to describe one particular curriculum as "the primary school curriculum" suitable for every school and every nation. The curriculum should be constructed, at least in part, in the context of the local school, the region and its resources, and the issues involved!

Problems in Curriculum Development

Worldwide, a number of problems arise when we attempt to develop curricula for environmental education (EE). We will deal briefly with several of the major problems in the following paragraphs.

The first problem is associated with *philosophy and goals*. Before developing a curriculum for EE we must decide exactly what it is we want that curriculum to accomplish, i.e., what it is the learner should be able to do as a result of instruction. Not doing this leads to any number of uncertainties. We are uncertain about our goals. We are uncertain about what to build into a curriculum. And we are uncertain about what instructional strategies to employ. This can result in failing to teach for goal-centered in-depth learning and the transfer of that learning to new and important situations, two major needs in EE.

The second problem is associated with a *scientific research base* upon which to make curriculum decisions. Many responsible educators agree that an ultimate goal of EE is to produce learners who can act responsibly in an environmental dimension. Often, however, curriculum developers make intuitive judgments about what the curriculum should look like. They make this important judgment based on what we will call "traditional wisdom."

This traditional wisdom simply holds that if we teach learners about the environment and its problems we will, in turn, make them more aware of environmental threats and, thus, more willing to act in responsible citizenship dimensions. We call this the knowledge > awareness > behavior model. It has never worked well, nor will it ever work well with large numbers of learners at any level. Fortunately, there is a growing research reservoir available in the literature which focuses on the variables associated with the development of responsible environmental behavior. Unfortunately, many environmental educators are not aware of this research, do not have access to it, or choose not to use it.

The third problem is associated with *instructional integrity* within a curricular framework. Instructional integrity refers to the relationship and consistency between the components of instruction. It is often the case in environmental education that content is poorly sequenced or that instructors teach subject matter content not associated with the objectives or that students are evaluated on a set of objectives quite different from the ones communicated to them initially. Instructional integrity is of paramount importance to effective instruction.

The fourth problem is associated with the *implementation of curricula*. Far too often an attempt is made to change what happens in schools without making investments which will truly change it. One investment relates to a *commitment* to see the implementation through to fruition. A second investment relates to a willingness to invest

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in the education of staff. The instructional methods used in effective environmental education programs are ones often not taught in teacher preparation programs. Therefore, inservice teachers are asked to make major changes in the instructional strategies used with learners in their classrooms. This necessitates a substantial *investment* in inservice teacher education.

To summarize, major curricular problems can be identified in association with: (1) a sound philosophy of environmental education; (2) the use of research findings on which to make curricular decisions; (3) guaranteeing instructional integrity within the curriculum; and (4) making a serious commitment to and a substantial investment in staff training.

Guidelines For EE Curriculum Development

Sooner or later we must make some assumptions about the goals and objectives for a primary school EE curriculum. But, before we do, let us lay out some rather critical guidelines that should be followed in any EE curriculum development project. These guidelines were adapted from the Unesco-UNEP International Environmental Education Programme, Environmental Education Series 22, *Procedures for Developing an Environmental Education Curriculum*, 73-75. These guidelines provide a great deal of power to the curriculum developer and should be respected. They follow:

Planning and Development Guidelines

1. **The curriculum developer(s) must know, before starting, what their philosophy is and what their goals must be.** We must be able to identify and communicate our philosophical perspective and clearly understand what it is we want the learners to be able to do, to know, and to accomplish at the end of their contact with the curriculum.

2. **The curriculum developer(s) must be willing and able to make instructional decisions which are consistent with carefully thought out and correctly sequenced goals.** [Examples: Goals are inferred in the Tbilisi Objectives and are also operationally defined through the Goals for Curriculum Development found elsewhere in this document.]

3. **The format for curriculum implementation must be decided in the beginning.** It can be implemented as a single and separate subject or it can be implemented on an infusion basis. This decision will control how the curriculum looks but not the goals it addresses.

4. **The developed curriculum must provide for the acquisition and transfer of critically important knowledge, skills, and attitudes.** In order to succeed, the environmental curriculum must provide for both the acquisition and transfer of knowledge, skills, and attitudes by learners to environmental issues both within the school and out in the community.

5. **The curriculum developers must recognize that a variety of instructional models must be considered in any curriculum development process.** Different instructional models are effective for different things and should be responsibly utilized. Relying only on one instructional model often dooms a curriculum to failure.

6. **Curriculum development should enjoy the combined efforts of a variety of experts.** Of course, curriculum and content specialists should coordinate the project but they should welcome input from other school personnel as well as from external consultants and a variety of community members. The environment is so broad a topic as to demand the help of a variety of experts.

7. **Community and regional resources should be surveyed and inventoried for use in the program.** A good EE curriculum will rely, in part, on the resources of the community and region. These resources must be made accessible as part of the overall curriculum. In addition, the resources must be known to the teachers so that they will be utilized.

8. **The completed curriculum must not be looked upon as "supplementary."** There are numerous supplementary "curricula" available and some of them have been distributed worldwide. However, we know of no supplementary materials that have a scope and sequence that accomplishes the goals described elsewhere in this paper. Supplementary materials can be part of a curriculum, but they must not be considered as a fully developed curriculum.

Implementation Guidelines

9. The school or the agency responsible for the school must be willing and able to find the resources necessary to guarantee a successful implementation of the curriculum. Few preservice or inservice programs do a good job of preparing teachers to adequately use EE materials and, in particular, a curriculum that has scope and sequence. Therefore, the resources must be made available to prepare teachers to implement the curriculum.

10. In-school and out-of-school vested interest groups need to be made aware of the new curriculum and their support must be secured in order for the new curriculum to be successful.

Evaluation Guidelines

11. A comprehensive program for evaluating the EE curriculum is necessary to determine a number of needs. Among the reasons for having a comprehensive evaluation program are: (1) to measure the extent to which learners have acquired the knowledge, skills, and attitudes which are desired; (2) to measure the effectiveness of those who are responsible for teaching the curriculum; and (3) to determine the extent to which the curriculum needs revision.

> **Behavior in the environmental dimension is complicated! This makes curriculum development difficult.**

A Discussion on Goals and Objectives for EE

Once again, a very important assumption is going to be made which focuses on the desire of all environmental educators and curriculum developers to produce a curriculum which will result in learners who exhibit responsible citizenship behaviors. If this is true, the following discussion will prove extremely important.

Behavior in the environmental dimension is complicated! This makes curriculum development difficult. This difficulty probably resulted in the very common and false assumption that knowledge about the environment leads to awareness which leads to behavior. Again, we are talking of the faulty knowledge > awareness > behavior model.

The lack of instruction which focuses on students learning to investigate, evaluate, and help resolve environmental issues is contrary to the recommendations for environmental education objectives contained in both the 1977 Belgrade Charter and in the 1977 Tbilisi Intergovernmental Conference Report.

What will objectives and curricula that focus on issue investigation, issue evaluation, and citizenship action strategies do for learners? The research into the matter is quite clear. This kind of instruction - focused on these kinds of objectives - provides the learner with an "ownership" of issues and a feeling of "empowerment" to do something about them. Thus, learners become closely involved with issues and are motivated and competent to try to help resolve them.

Curricular goals for EE do exist which incorporate the variables related to "ownership" and "empowerment". Such a set of goals was developed in the early '80s and has subsequently been used in various parts of the world as a guide for curriculum development and research. This set of goals appears below and on the following pages:

Goals For Curriculum Development In Environmental Education

The Superordinate Goal: . . . to aid citizens in becoming environmentally knowledgeable and, above all, skilled and dedicated citizens who are willing to work, individually and collectively, toward achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment.

Goal Level I. The Ecological Foundations Level

This level seeks to provide learners with sufficient ecological knowledge to permit the making of ecologically sound decisions with respect to environmental issues. The Ecological Foundations Level would minimally include the following conceptual components:

A. Individuals and populations.
B. Interactions and interdependence.
C. Environmental influences and limiting factors.
D. Energy flow and nutrient cycling.
E. Community and ecosystem concepts.
F. Homeostasis.
G. Succession.
H. Humans as a members of ecosystems.
I. The ecological implications of human activities and communities.

Goal Level II. The Conceptual Awareness Level - Issues and Values

This level seeks to guide the development of a conceptual awareness of how individual and collective actions may influence the relationship between quality of life and the quality of the environment, and also how these actions result in environmental issues which must be resolved through investigation, evaluation, values clarification, decision making, and finally, citizenship action. Goals at this level are formulated to provide opportunities for receivers to conceptualize .

A. . . . how human cultural activities, e.g., religious, economic, political, social, etc. influence the environment from an ecological perspective.

B. . . . how individual behaviors impact on the environment from an ecological perspective.

C. . . . a wide variety of environmental issues and the ecological and cultural implications of these issues.

D. . . . the alternative solutions available for solving environmental issues and the ecological and cultural implications of these solutions.

E. . . . the need for environmental issue investigation and evaluation as a prerequisite to sound decision making.

F. . . . the roles played by differing human values in issues and the need for personal values clarification as an integral part of environmental decision making.

G. . . . the need for responsible citizenship action in resolving environmental issues.

Goal Level III. The Investigation and Evaluation Level

This level provides for the development of the knowledge and skills necessary to permit learners to investigate environmental issues and evaluate alternative solutions for solving these issues. Similarly, values are clarified with respect to these issues and alternative solutions. Goals at this level are presented in two components.

Component A: Goals for Component A are to develop in learners . . .

A. . . . the knowledge and skills needed to identify and investigate issues and to synthesize the gathered information.

B. . . . the ability to analyze environmental issues and the associated value perspectives with respect to their ecological and cultural implications.

C. . . . the ability to identify alternative solutions for specific issues and the value perspectives associated with these solutions.

D. . . . the ability to evaluate alternative solutions and associated value perspectives for specific issues with respect to their cultural and ecological implications.

E. . . . the ability to identify and clarify their own value positions related to specific issues and their associated solutions.

F. . . . the ability to evaluate, clarify, and change their own values positions in light of new information.

Component B: Goals for Component B are to provide learners with opportunities to . . .

G. . . . participate in environmental issue investigation and evaluation.

H. . . . participate in the valuing process in a manner as to permit the learner to evaluate the extent to which his/her values are consistent with the superordinate goal for environmental education.

Goal Level IV. Action Skills Level - Training and Application

This level seeks to guide the development of those skills necessary for receivers to take positive environmental action for the purpose of achieving and/or maintaining a dynamic equilibrium between quality of life and the quality of the environment. Goals at this level are presented in two components.

Component A: The goal for Component A is to develop in learners . . .

A. . . . those skills which will permit them to effectively work toward ends which are consistent with their values and take either individual or group action when appropriate.

Component B: Goals for Component B are to provide learners with opportunities to . . .

B. . . . make decisions concerning action strategies to be used with respect to particular environmental issues.

C. . . . apply action skills to specific issues, i.e., to take citizen action on one or more issues.

D. . . . evaluate the actions taken with respect to their influence on achieving and/or maintaining a dynamic equilibrium between the quality of life and the quality of the environment.

Educating for Responsible Citizenship Behavior

Given all that has preceded this section, one should be able to identify a number of critical components of a total educational program for environmental education *if changes in learner behavior are desired.* Among these critical components are ones which *can be facilitated* by formal and nonformal educational agencies.

What are the Critical Curricular Components?

It appears that we can maximize opportunities to change learner behavior in the environmental dimension if curriculum developers will . . .

1. . . . provide a curriculum that will teach environmentally significant ecological concepts and the environmental interrelationships that exist within and between these concepts.

There is no doubt that ecological literacy is important to sound environmental decision making. In order to approach issue resolution in a responsible way, learners must be able to identify the ecological consequences related to both issues and their proposed solutions, in addition to the social and cultural ramifications of issues and solutions.

2. . . . provide a curriculum in which there can be carefully designed and in-depth opportunities for learners to achieve some level of environmental sensitivity which will promote a desire to behave in appropriate ways.

Environmental sensitivity can be defined as an empathetic or understanding view of the environment. It is a view that respects ecological stability and promotes the idea that humans must live in harmony with the natural environment. It appears that we must provide opportunities for learners (both individually and in small groups) to spend time in the outdoors. Activities would include both educational and recreational pastimes. Most importantly, teachers who work with learners should themselves model environmental sensitivity for the children.

3. . . . provide a curriculum that will result in an in-depth knowledge of issues.

Over the course of the primary years, students should become knowledgeable about a large array of environmental issues. Ideally, these issues would be local in nature at the early years, and expand into more regional, national, and international concerns at succeeding grade levels. In addition, as learners grow older, their information about issues should increase in depth and quality.

4. . . . provide a curriculum that will teach learners the skills of issue analysis and investigation as well as provide the time needed for the application of these skills.

The skills associated with issue analysis and investigation are many, some of them quite sophisticated. Without an opportunity to apply and practice these skills, it is doubtful that they will be retained.

Briefly, these skills include: discriminating between events, problems, and issues; identifying and analyzing issues; generating research questions; accessing information from print (and other) resources; designing and conducting surveys; collecting data; generating data-based conclusions, inferences, and recommendations; interpreting and communicating data; and evaluating alternative solutions and their consequences.

Without an opportunity to apply and practice [issue investigation] skills, it is doubtful that they will be retained.

5. . . . provide a curriculum that will teach learners the citizenship skills needed for issue remediation as well as the time needed for the application of these skills.

Again, these skills are important ones, which are better learned and retained when opportunities are provided for practice and application. These skills include the major methods of citizenship participation available to individuals, e.g., ecomanagement, persuasion, consumer action, political action, legal action, etc. Also included among these skills are the analysis of the effectiveness of individual versus group action, and the development of issue resolution plans. Of critical importance is the ability to evaluate such a plan in terms of its social, cultural, and ecological implications.

6. . . . provide a curriculum that will allow for instructional settings which will increase learners' expectancy of reinforcement for acting in responsible ways, i.e., attempt to develop an internal locus of control in learners.

Research tells us that an important factor in whether an individual will engage in environmentally responsible behavior is that person's locus of control, or feeling of effectiveness. Simply put, we are more likely to undertake an action if we feel we will successfully accomplish it. In other words, success in action taking increases the likelihood of future action taking.

If we wish to help learners develop an internal locus of control, it appears important to provide them with the tools they need to engage in issue resolution (see #5, above) and to provide them with opportunities to become involved in helping to resolve environmental issues.

7. . . . provide a curriculum that does not end in the primary school but one that has a scope and sequence which permits sophisticated issue investigation and resolution beyond that appropriate for primary age students, e.g., investigating and evaluating national and international issues as well as local and regional ones.

An articulated curriculum across the primary grades and beyond is crucial. An important consideration in teaching for environmentally responsible behavior is that of reinforcement. Instruction focused on issue investigation and resolution does increase learner involvement in environmentally positive behavior. However, unless reinforcement and continued support is provided, this behavior appears to erode over time. How can that support be provided? Ideally, by involving learners in environmental issues and their resolution beginning in the early grades and continuing throughout their formal schooling.

The issues addressed in the early grades would be ones of local significance upon which learners could have a positive impact. With succeeding grade levels, the coverage of environmental issues should expand both in terms of scope, i.e., including regional, national, and international issues, as well as local ones, and in terms of the complexity of issues addressed.

Similarly, student involvement would increase relative to their abilities. At the early grades, one would expect to involve students in teacher-led class projects (issue investigations and action plans), whereas students at the upper elementary and secondary levels would be expected to become involved in individual (or small group) investigations and actions plans.

This kind of instruction provides the learner with an "ownership" of issues and a feeling of "empowerment" to do something about them. Thus, learners become closely involved with issues and are motivated and competent to try to help to resolve them.

What Might We Observe in an Implemented Curriculum for the Primary School?

As noted earlier, it is almost impossible to produce a single primary school EE curriculum for all schools to implement. That is simply because the curriculum must be responsive to local needs, issues, and resources. However, we can definitely discuss some elements that might be observed in such a curriculum based upon the goals presented above and upon what we have seen young learners do in the United States.

Very young children (ages 5 and 6) are generally considered to be unable to make abstract generalizations. In part this is true. However, we have seen teachers help these young students: (1) learn what an ecological community is and that it is dependent on a movement of food energy from organisms to organisms; (2) learn what the term "environment" means; (3) learn what air and noise pollution are as well as problems associated with solid waste disposal; (4) decide whether pollution is positive or negative; (5) decide what they, as children, can do about pollution and waste disposal.

We find that young learners can conceptualize these things very well if concrete experiences are used. We also find that they can identify actions that they can take about these problems. And, somewhat surprisingly, they can choose between what they can do and what adults can do. These findings have led us to decide that we often underes-

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timate children in terms of what they are able to learn.

We have even observed early primary teachers help their young learners to set up litter control programs. In one instance, a group of very young learners set up a source separation program for trash in their school. This program was successful in an environmental sense, and won an important award for the children and their teacher.

. . . we often underestimate children in terms of what they are able to learn.

As children grow older, their experiences with ecological principles can produce expanded and more thorough concepts. We have observed primary school learners learning about population dynamics, nutrient cycling, succession, homeostasis, etc. These concepts can be initiated in class through a variety of activities and further developed out-of-doors as teachers use community and regional resources for their instruction.

With respect to the environment per se, children can be guided by their teachers to explore environmental issues of local significance. We have observed young learners, ages 6-10, conceptualize, investigate, and attempt to make personal and group decisions about such issues as: (1) endangered species, e.g., eagles, prairie chickens, wolves; (2) tropical rain forest deforestation; (3) solid waste management, e.g., recycling, composting; and (4) wildlife management, e.g., coyotes, white-deer, Canada geese. These learners were not in "advanced" classes, rather they were the learners you would find in an "average" classroom. They were real children, with real teachers, in schools with a wide variety of settings.

The issues these learners dealt with were brought into focus by the development of what we refer to as an "Extended Case Study." An Extended Case Study is a case study that takes the learner beyond just becoming aware of the issue. It asks the learner to critically analyze the issue, collect data concerning the issue, interpret the collected data, and come up with an "action plan" to try to help remediate the issue. Often, these investigations are coordinated and lead by the teacher.

As students become more sophisticated with their issue investigations, they can be trained in the skills of individual issue investigation and evaluation. Research has shown that learners, ages eleven and above, can be trained for issue investigation and can be expected to conduct excellent investigations on their own. The teachers of these learners are delighted to report that individual students become experts on the issues selected for investigation, often teaching a great deal to both classmates and teacher!

What is interesting about all of these age levels is that learners can deal, at some intellectual level, with citizenship responsibility. Even very young learners can become active in school, at home and in their neighborhoods. As primary learners grow older, they can begin to learn some very sophisticated strategies for responsible citizenship action. And, subsequent to their own issue investigations, they can be required to develop and evaluate their own action plans. In this way, they not only gain "ownership" of the issues they have worked on but they feel "empowered" to try and do something about them.

By the time learners leave the primary school they should be very sophisticated in their knowledge of ecology, have a large reservoir of information concerning environmental problems and issues, be able to critically analyze issues, be able to thoroughly investigate and evaluate environmental issues, and be able to develop and apply strategies for helping to resolve those same issues. As responsible environmental educators, it is our task to develop and implement curricula which will enable learners to achieve these goals.

An articulated curriculum across grade levels is crucial. . . . unless reinforcement and continued support is provided, [citizenship] behavior appears to erode over time.

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" . .. a hot bone of contention in the entire western Montana, is our Highway 93 which has been dubbed the deadliest highway in the state. And there is controversy as to whether to widen it to a four-lane or a super two-lane and the environmental impacts of that. For two years now several groups of students have investigate that. The first year that they investigated it, I had a lot of tribal member students who conducted [research using] questionnaires and opinionnaires about the same time that the tribal government was conducting theirs and [the students] came up with exactly the opposite information that was published to the public from the tribe, which created some interesting questions, not only at school, but the kids went to their tribal elders and started asking questions and wanting to know why. And that was a very good learning experience for them and it was an eye-opening experience for our tribal government because they realized that their kids were interested in what they were doing and they were paying attention.

Another issue that a student investigated two years ago was the reintroduction of the trumpeter swan to the Flathead Indian Reservation and she actually went out and was able to assist in the release of these animals and has since, for two years now, worked with the biologist in charge of monitoring the migration patterns, when they come back, when they leave, if they all come back. And so, she's actually carried on being able to be a part of the continuing research that's going into that. The biologist has been very grateful for her help. She does the little things that he might not have time to do and in the process is getting more interested in some type of biological science."

The words of a Montana Middle School Teacher. From an interview conducted with her by Versil Withrow, Workshop Coordinator for The Center for Instruction, Staff Development and Evaluation, 1997.

Environmental Education in the K-12 Curriculum: Finding a Niche

John M. Ramsey, Harold R. Hungerford, and Trudi L. Volk

In this 1992 article, the authors told the reader that significant progress had been made in the United States regarding environmental decision making by the government, businesses, households and individuals. However, there appeared to be no parallel trend in the nation's K-12 schools. The situation remains largely unchanged today.

In addition, this reading reviews the basic precepts of environmental education, summarizes state-level efforts directed at its establishment, and makes suggestions for systematically incorporating it into the K-12 curriculum. One of the very significant features of this reading is the rather detailed tables which show what concepts skills could successfully be infused into existing courses across the middle school years.

Introduction

World citizens came together for Earth Day 1990, a 20-year anniversary of the first Earth Day. Like its predecessor, Earth Day 1990 spawned universal testimony and reaffirmation of the level of concern and significance of the human role in the natural world. It symbolized the problematic interactions between the quality of life and the quality of the environment for the planet's inhabitants. And once more, the world looked to its educational system for answers.

The defense and improvement of the environment on behalf of present and future generations of all living things has become an imperative educational goal. The message of Earth Day is that each individual must recognize and accept this goal and become an active participant in working toward its achievement. Because education is the vehicle through which society prepares its citizens to carry out their responsibilities, education must be environmental. This task identifies another major challenge for all educational systems and their decision makers.

The task of recasting U.S. K-12 curricula in an environmental dimension poses not only significant challenges but also untapped potential, particularly with respect to opportunities for interdisciplinary configurations. The curricular and instructional tools necessary for effective, systematic K-12 education about the environment (EE) are available. These EE strategies spring from widely accepted parameters of educational, cognitive, and social learning theories. The real task is not who, what, or how. It is when and where—the committed integration of effective and systematic EE approaches into existing K-12 curricular frameworks. For a variety of administrative, curricular, and instructional reasons, this task will not be an easy one.

Because of its multifaceted nature, environmental education means different things to different educators. The phrase "environmental education" might trigger concepts of ecology, environmental science, outdoor education, or [environmental] issue instruction - each of which might fit under the EE umbrella [or be related to it in some dimension] and each of which offers only a partial contribution to the total package. Hence, both conceptual ambiguities and communication risks exist with the use of the phrase "environmental education." The task at hand is to present a conceptual framework and the curricular models that will provide both integrity and utility in the quest for developing K-12 EE curricula.

> **The curricular and instructional tools necessary for effective, systematic ... environmental education are available.**

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A Curricular Framework for EE

Environmental education must prepare individuals to be responsive to a rapidly changing technological world, to understand contemporary world problems, and to provide the skills needed to play an effective role in the improvement and maintenance of the environment. Therefore, EE must incorporate many aspects of the environment: natural and manmade, technological, social, economic, political, cultural, and aesthetic. Further, EE must emphasize and bridge from the personal, local, and national to the global in linking the actions of today with the consequences of tomorrow.

Given the description above, the following superordinate goal statement sets forth the desired end result of a K-12 EE program:

> The goal of environmental education is to help students become environmentally knowledgeable, skilled, and dedicated citizens who are willing to work, individually and collectively, toward achieving and maintaining a dynamic equilibrium between the quality of life and the quality of the environment. (Hungerford and Peyton 1976, p. 2)

This EE goal statement implies a continuum of objective clusters that serve as guides for curriculum and instruction development. These objectives, originally established in the Tbilisi Declaration (Conference declaration 1977), are as follows:

> *Awareness:* Helping students acquire an awareness and sensitivity to the total environment and its problems; develop the ability to perceive and discriminate among stimuli; process, refine, and extend these perceptions; and use this new ability in a variety of contexts.
>
> *Knowledge:* Helping students acquire a basic understanding of how the environment functions, how people interact with the environment, and how issues and problems dealing with the environment arise and how they can be resolved.
>
> *Attitudes:* Helping students acquire a set of values and a feeling of concern for the environment and the motivation and commitment to participate in environmental maintenance and improvement.
>
> *Skills:* Helping students acquire the skills needed to identify, investigate, and contribute to the resolution of environmental problems and issues.
>
> *Participation:* Helping students acquire experience in using their acquired knowledge and skills in taking thoughtful, positive action toward the resolution of environmental problems and issues.

Environmental education must prepare individuals to be responsive to a rapidly changing technological world, to understand contemporary world problems, and to provide the skills needed to play an effective role in the improvement and maintenance of the environment.

Making curriculum-related decisions is always difficult. These tasks can be facilitated if planners have a cohesive and valid set of goals. Using the Tbilisi objectives presented above as a model, Hungerford, Peyton, and Wilke (1980) developed a set of curriculum development goals for environmental education. Those goals encompass the following four levels of cognitive knowledge and skills within a broad scope of environmental literacy: (a) ecological foundations; (b) issue awareness; (c) investigation and evaluation; and (d) issue resolution. The first two goal levels, foundations and awareness, focus on conceptual awareness of ecological principles and environmental issues. The latter levels include goals that deal with the development and application of skills prerequisite to investigating and evaluating issues and to participating in the remediation of these issues. Interested readers should see Hungerford, Peyton, and Wilke (1980) for a complete listing of the four goal levels and attendant 20 goal statements.

EE Program Characteristics

The goals and objectives of environmental education imply a number of discrete programmatic characteristics. Engelson (1986) claims that EE programs can be described as follows:

- *Action-oriented:* Involving students in the resolution of real environmental problems and issues.
- *Continuous:* Part of all subject areas at all grade levels but not precluding specific curricula and instruction focused solely at EE.

- *Experiential:* Using a diverse array of learning approaches and environment.

- *Future-oriented:* Concerned about future as well as present generations.

- *Globally-oriented:* Considering the Earth as a single ecosystem.

- *Holistic:* Dealing with the natural, manmade, technological, social, economic, political, cultural, moral, and aesthetic aspects of the environment.

- *Interdisciplinary:* Drawing content from all disciplines.

- *Issue-oriented:* Dealing with issues having local, regional, national, and international perspectives.

- *Neutral:* Approaching issues and problems without bias, where the classroom is a forum where all points of view should be heard.

What Is the Status of EE in Schools?

"Environmental education" has been a curricular buzzword since the 1960s. How has this momentum been translated into K-12 curricular programs? The last national curricular study of environmental education (Childress 1978) suggests that most of that energy has been dissipated in discussion. Environmental education, if it exists at all, is loosely organized and has little sense of direction. The Childress study of 301 environmental education programs found that less than 40% of those surveyed considered the following to be "primary" objectives:

- Synthesizing various alternative solutions to environmental problems into a comprehensive plan.

- Analyzing the role of contributing factors (technology, legislation, etc.) to the causes of environmental problems.

- Evaluating how varying value systems modify and shape the environment.

- Developing proficiency in environmental data collection.

Childress concluded that most EE programs placed more emphasis on knowledge of the environment and an appreciation of its resources rather than on helping students develop the knowledge and skills to solve environmental problems. It seems that most programs do not embrace or focus on a clearly delineated goal framework. Without reference to a cohesive frame of reference such as the goals and objectives described above, education about the environment is a curricular glut - multifaceted, unorganized, fragmented, and probably ineffective.

... education about the environment is a curricular glut - multifaceted, unorganized, fragmented, and probably ineffective.

The discussion above concerns only the school curricula that have attempted to do something in the name of environmental education. EE has not found an established niche in the U.S. schooling process. Most school-based educators have not adopted a frame of reference for either EE curriculum or instruction, although they are widely used in nonformal contexts (e.g., in zoos, museums, and parks). EE in U.S. schools is not theoretical, systematic, or comprehensive.

State-Level EE Initiatives

Despite EE's lack of status in U.S. schools, several states have begun to exercise "top-down" leadership in establishing EE in the school curriculum. During the 1980s, lawmakers in Arizona, Florida, Iowa, Pennsylvania, and Wisconsin enacted a variety of legislation that, in part, promoted EE within local school districts' curricula. Wisconsin's efforts, for example, represent a serious attempt to deal with the problem of EE in schools.

Wisconsin's initiatives, as a component of a larger statewide educational reform package, included: (a) a preservice environmental educational requirement for about two-thirds of all teachers (i.e., early childhood, elementary, agriculture, science, and social studies) applying for state certification; (b) the development of an environmental educational curriculum planning guide; (c) the creation of a school district standard requiring environment education curriculum planning, development, implementation, and evaluation; (d) the creation of standards for secondary level teacher preparation programs in the environmental studies; and (e) the establishment of the Wisconsin Environmental Education Board. This board oversees environmental education programs and identifies needs and priorities for environmental education in the state and private sectors. Legislation was also passed to create the Wisconsin Center for Environmental Education. The center's role is to provide expertise to schools in the preparation of curricula and the preparation of inservice teachers (Engelson 1986).

Wisconsin is employing an infusion model that requires the systematic incorporation of EE into existing district curriculum plans. To support planning at the district level, Wisconsin has developed an EE curriculum planning guide that prescribes goals and objectives and suggests curricular and instructional strategies. Further, to a more limited extent, expertise has been made available to district planning units. As of fall 1990, all school districts in Wisconsin were required to develop, adopt, and submit curriculum plans that infuse EE into the existing curricular framework. Accountability will be achieved every 3 years via on-site audits in which the district's written plans are compared with its educational practices. The Wisconsin legislature has also mandated periodic assessment of the environmental literacy of the state's teachers and students. Wisconsin seems to have made significant progress in its attempt to achieve systematic, comprehensive, statewide education about the environment in its public schools. Because of the recent timelines of Wisconsin's efforts, the outcomes are yet to be determined. The status of state-level activity in most other states is much less compelling.

EE in Schools: Insertion or Infusion?

School administrators and curricula planners must face the dilemma of curricula filled with the demands of an array of discipline-based, societal-based, and learner-based needs. How can EE curricula be reasonably framed? [Three questions need answering:]

- Can appropriate new courses be inserted into the curriculum?
- Can appropriate EE strategies be infused into existing curricula?
- Can existing curricula be appropriately modified, that is, "environmentalized?"

The answer to all three questions is yes. In fact, all three approaches might well be needed to achieve a systematic, comprehensive curricular package.

Before dealing with generic curricular factors (e.g., scope and sequence, infusion), we review two EE instructional models built around the goal framework presented above. One model, the Case Study, was designed for infusion into existing K-12 curricula. The other model, Issue Investigation Skill, was designed to stand alone, requiring insertion into grade 6-12 curriculum. These strategies represent examples of approaches that can be used by curriculum planners in "environmentalizing" the curriculum. A comparison of each approach will allow the benefits and problems associated with each to emerge.

The EE Case Study Format

The case study is a teacher-directed analysis of a particular environmental issue. It is an instructional method that uses both primary and secondary sources to deliver issue-focused information and skills to the student. In other words, original sources are, at least initially, used by the teacher to develop a foundation of knowledge concerning the issue. Once students are oriented to the issue, the teacher provides students with the skills needed to investigate the issue on a class or small-group basis. Such a strategy could involve the students in a search for additional secondary information sources. Or, it could involve a class decision concerning information needed or questions needing answering at the local or community level. This could well lead to instruction on the development of survey instruments (questionnaires and/or opinionnaires) and the development of a survey that the entire class would administer within the community. Of course, this would lead to the collection of primary data that would be recorded and interpreted. Once class decisions are made concerning what should be done with respect to the issue, the time is ripe for citizenship action training and the eventual development of an action plan that may or may not be implemented, depending upon decisions made by the class or teacher. This, in short, describes a case study.

A model issue instruction case study for grades 5-12 has been formalized and published, that is, *A Science-Technology-Society Case Study: Municipal Solid Waste* (Ramsey, Hungerford, and Volk 1996). This case study provides a model for teachers who wish to prepare case studies using issues of their choice.

The case study provides the teacher with a substantial amount of flexibility and control. The extent to which the issue is dealt with is in the hands of the teacher. The teacher can choose the issue, determine the methods to be used, make decisions concerning the depth to which the issue will be studied, select the content area in which the area will be infused, and determine the length of time spent on the case study. Ample opportunities are available for both individual, large-group, or cooperative learning formats.

VIGNETTE 1

The Wisconsin Department of Natural Resources (WDNR) proposed the reintroduction of the timber wolf in several northern Wisconsin counties. This plan became the focus of a controversial issue throughout the region. A fifth grade teacher used that issue as the focus of her case study, The Timber Wolf Reintroduction Case Study. Instruction began with the natural history of the timber wolf and its ecological role in natural systems. The next level of instruction focused on students learning how to identify the positions, beliefs, and values of players in the timber wolf issue, using an issue analysis strategy. This was followed by the construction of a concept map of important aspects of the issue. (These information-processing activities are designed to help students achieve in-depth understanding of the issue.) Collectively, these activities generated a comprehension of the issue as well as a number of questions that could become the focus of an investigation.

The next part of the case study, the problem-solving stage, involved the students in designing and carrying out an investigation based on the questions generated by the prior activities. The class decided to find out how many regional residents supported the reintroduction of the timber wolf. They randomly selected more than 300 residents in seven contiguous counties of northern Wisconsin. Hand-written cover letters and a typed questionnaire were prepared by the students and mailed to the selected residents.

More than 200 of the questionnaires were returned. Data were compiled, and a report of the findings was prepared and submitted to the WDNR as well as to regional newspapers. Some of the study's respondents sent the students stories and anecdotes about personal stories and other remembrances concerning wolves. A few of these individuals were invited to the class for presentations. As the case study unfolded, numerous language arts, social studies, creative writing, art, and math activities were conducted in addition to the numerous science lessons.

There is, however, a price to be paid for flexibility and control! The costs involve time, energy, and skill in putting the case study together. Most issue case studies are a do-it-yourself curriculum with the classroom teacher as the curriculum designer. Although students can be involved in the selection of a case study, that responsibility generally rests with the teacher, as does the responsibility for finding and selecting original sources such as video tapes, printed matter, guest speakers, panel members, film, field trips, or simulations. Decisions must be made about the specific learning outcomes desired. Handouts must be prepared. Evaluation instruments must be designed and evaluated. The development of a case study is not an easy task.

Another problem with the case study format relates to student interests. The teacher will not be able to meet the interests of all students using the case study format. This is rather a severe limitation when there are a number of students who would like to investigate issues other than the one being studied by the class. This limitation is counteracted by using the issue investigation skill format.

You might wonder how the case study infusion might work in the classroom. Consider Vignette 1 about a fifth grade teacher who developed and infused a case study into the curriculum. This unit, *The Timber Wolf Reintroduction Case Study*, consisted of four parts beginning with science knowledge, progressing to processing information about and investigating the wolf issue, and culminating in decision making. Those components were integrated into an unfolding "storyline" that served as a skeleton for a number of other interdisciplinary and multidisciplinary activities.

The Issue Investigation Skill Format

The case study approach to issue investigation focuses on only issue category, for example, timber wolf reintroduction. The issue itself is the intent of case study instruction. As such, the instructional activities are issue specific. In contrast, the investigation skill methodology employs a broader, more generalizable approach to the process of issue investigation. The intent of the issue investigation methodology is to develop in students the capabilities (skills) in issue investigation and resolution - capabilities that can be used throughout their lives as citizens.

Like the case study approach, the investigation skill format uses instructional activities structured around the four issue instruction goal levels described earlier. However, unlike the case study approach, the investigation skill method defines, practices, and applies the generic knowledge and skills needed by students to independently investigate and resolve issues. This process culminates in an investigation of a science-related social issue of the student's own choosing and the development of an action plan for resolving that issue.

> **. . . unlike the case study approach, the investigation skill method defines, practices, and applies the generic knowledge and skills needed by students to independently investigate and resolve issues. This process culminates in an investigation of a science-related social issue of the student's own choosing and the development of an action plan for resolving that issue.**

The investigation skill methodology for grades 6-12 has been formalized and published, that is, *Investigating and Evaluating Environmental Issues and Actions: Skill Development Program* (Hungerford et al. 1996). The investigation skill program is organized into a series of six chapters. The chapters are interdisciplinary in nature and introduce students to the characteristics of issues and the skills needed for obtaining and processing information, investigating and analyzing issues, and resolving issues. The descriptions [to the right] provide a brief overview of each chapter.

This skill development approach provides a powerful vehicle for the investigation of a multitude of different science-related issues by students. The effectiveness of this methodology has been validated by research findings that indicate that issue investigation training fostered responsible and independent citizenship behavior on the part of seventh and eighth grade students (Ramsey, Hungerford, and Tomera 1981). The investigation skill approach is probably more effective at fostering responsible citizenship behavior than the issue case study. The case study typically focuses on a single issue selected by the teacher, thus delimiting exposure to an array of issues investigated by classmates and the ownership that comes with identifying and investigating one's own issue.

Most instructional methods, including the investigation skill approach, have a variety of problems and limitations. Teachers have typically found that a complete 18-week semester is needed to complete the instructional objectives in the skill development program. Thus, this type of program must be inserted into the curriculum. Further, a variety of classroom management skills are critical in those aspects of instruction where the teacher acts as a facilitator between resources and students in the process of investigating an array of science-related social issues. In particular, some teachers have found it difficult to make the transition from direct instruction to a role that demands advising and consulting. Allowing students to investigate issues independently is evidently viewed as an unfamiliar departure from the "traditional" classroom management practiced by many teachers.

Chapter I: An Introduction to Issue Investigation.

Learners discriminate among events, problems, and issues. The impact of beliefs and values on environmental issues is explored and analysis is introduced and practiced. The concept of "interaction," so crucial in the sciences and social studies, is also introduced, demonstrated, and applied.

Chapter II. The Basics of Issue Investigation.

Learners identify environmental issues, write research questions, learn how to gain information from secondary sources as well as learn how to compare and evaluate information sources.

Chapter III. Using Surveys, Opinionnaires, and Questionnaires.

Students learn how to obtain information using primary methods of investigation. Initially, they learn how to develop surveys, opinionnaires, and questionnaires. Subsequently, they learn sampling techniques and how to administer data collection instruments as well as how to record those data.

Chapter IV. Interpreting Data.

Students learn how to draw conclusions, make inferences, and formulate recommendations. Further, they learn how to produce and interpret graphs.

Chapter V. Investigating an Issue.

Learners autonomously select and investigate an environmental issue. This process involves the application and synthesis of the skills learned thus far.

Chapter VI. Issue Resolution Training.

Students learn the major methods of citizenship action, analyze the effectiveness of individual versus group action, and develop issue resolution action plans. This "action plan" is evaluated against predetermined criteria to assess social, cultural, and ecological implications of citizenship actions. Finally, the action plan may be implemented at the discretion of the student.

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Consider the vignettes of individuals or teams of students conducting independent investigations as a function of learning issue investigation skills in the middle school classroom. Vignette 1 serves as an example of how environmental education can be infused into the classroom. The curricular vehicle, in this case, was a teacher-developed case study that closely adhered to the theoretical framework described earlier. Vignettes 2 and 3 serve as examples of products of instruction that were inserted into a middle school curriculum using the issue investigation skill strategy. The instructional examples presented above describe examples of environmental education in the classroom. However, some very important things are missing, namely, the actual planning and decision making about scope and sequence, infusion or insertion, as well as an array of other curricular and instructional questions.

Most administrators and curriculum planners believe it is simply not realistic to consider the insertion of EE into an already overloaded curriculum. That question will not be discussed. Rather, the process of infusing EE into the existing curricular framework will be explored in some depth in the following section.

Considering EE Infusion

Infusion is a relatively simple process to understand but a rather complex process to accomplish. Simply stated, infusion refers to the integration of content and skills into existing courses in a manner as to focus on that content (and/or skills) without jeopardizing the integrity of the courses themselves. In the case of environmental education, the educator carefully analyzes existing courses for places where environmental content and associated skills could be incorporated.

A key component in the infusion process rests with the faculty of the school attempting to incorporate an infused environmental education program. Any comprehensive infusion strategy demands a great deal of cooperation from staff members who are going to be responsible for the infused program. The faculty must be sympathetic toward the infusion and the members of that faculty must be willing to work cooperatively to build a plan for infusion and see that the plan is carried out. A major ingredient of that "plan" must be to respect the integrity of the scope and sequence in a manner that guarantees that instruction will proceed logically across content areas. Sometimes this can be accomplished by teachers working independently of others but often it necessitates "team teaching," with instructors from two or more content areas working cooperatively to deliver well-thought-out instruction.

VIGNETTE 2

An Illinois community was engaged in deciding what combination of recreational, agricultural, commercial, industrial, and wildlife habitat usage was appropriate for a section of state-owned land adjacent to a local river. A team of middle school students assessed community residents' opinions concerning the issue. Then, using the study's findings, they developed a "master plan" for the use and development of that public land. The plan was then submitted and defended at a public hearing sponsored by the State Department of Conservation. Among the farmers, boaters, bird watchers, business people, and others who spoke at the hearing, the students were the only participants who presented a proposal founded on data-based decision making.

If time and other resources permit, an "infusion institute" can be designed that would permit faculty members to be trained in infusion techniques and provide time for them to plan for the infusion of environmental content and skills. In addition, such an institute would allow participants to identify barriers to infusion and develop strategies for removing those barriers. This strategy will often counteract a common behavior that consists of looking for problems more diligently than looking for solutions. Human nature being what it is, excuses are far easier to come by than solutions to problems.

VIGNETTE 3

Illegal dumping has become an issue in many states. In southern Illinois, a county board of commissioners received several complaints from residents concerning illegal dumping on rural roads, abandoned strip mines, and creeks. A local eighth grade student decided to determine the extent of and the characteristics associated with the county's illegal dumping activity. The student's questionnaire, along with a copy of a county map, was sent to each county township road commissioner. Each commissioner reported the locations of illegal dump sites within his township. The student then visited each site to determine the extent of agricultural, automotive, commercial, and household wastes. A report of the findings, along with photographic evidence, was prepared and submitted to the county board of commissioners and published in the local newspaper. Further, the student used the investigation's data as the basis of a school science fair project.

Any comprehensive infusion strategy demands a great deal of cooperation from staff members who are going to be responsible for [planning] the infused program. ... A major ingredient of that "plan" must be to respect the integrity of the scope and sequence in a manner that guarantees that instruction will proceed logically across content areas.

Some Insights into Infusion

Over the past several years the authors have spent a good part of their professional lives training faculty members in environmental content and issue investigation strategies. One of the things to come out of this training is the knowledge that environmental content and skills can often be integrated into existing courses without interfering with the content and skills desired by involved faculty members.

Where can important environmental content be infused? In a middle school in New Jersey, for example, there was interest in implementing environmental issue instruction using a team teaching approach (infusing issue instruction into science, language arts, and social studies). The language arts teacher was skeptical; he was unsure whether this infusion would interfere with his program of skill development in the language arts. Even so, he agreed to study the components of issue investigation and respond to the challenge a day later. He came back to the group the next day and stated that the language process involved in issue instruction would meet more than 50% of his objectives. The social studies teacher, concerned that her students have an opportunity to study social problems, had no problem seeing the relationships that existed between environmental issues and social issues because all environmental issues have a strong social dimension. Of course, the science content was obvious.

In another instance where issue instruction was implemented in the middle school, the school librarian worked with the science teacher, assisting her with instruction in certain language skills and providing environmentally related secondary resources for the students. The librarian reported that she was astounded to find that the research skills of the issue-focused students were much better than the skills of other students. She was also impressed with the seriousness with which those students approached their library research. The students became so skilled in using secondary sources from the library that they did not need to be retaught library skills in subsequent years. One would not necessarily expect this kind of outcome from an environmental program, but this is exactly what happened.

We can cite numerous examples of two teachers working cooperatively, typically, science teachers working with social studies teachers or language arts teachers to meet the needs of learners. In all instances, some form of infusion was involved. Usually, the science teacher prompted the team teaching and the infusion, but not always. Sometimes, the social studies teacher led the way. It matters not! Infusion took place and cooperative teaching occurred.

In other instances, teachers of home economics and agriculture have requested training for infusing environmental content into their subject matter areas. Many environmentally related issues are suitable for home economics instruction, for example, those having to do with energy consumption and conservation, the relationships between human reproduction and family living, environmentally sound consumer behavior, home sanitation and disease, and toxic chemicals and food production. In agriculture, numerous environmental issues are available for infusion, for example, issues associated with food production, soil erosion, desertification, herbicides, insecticides, livestock grazing, and loss of agricultural land due to construction. Courses such as home economics and agriculture can play an important part in an overall infusion of environmental education in the middle school curriculum.

The investigation skill approach is probably more effective at fostering responsible citizenship behavior than the issue case study.

Inspecting a Middle School Scope and Sequence for Infusion Possibilities

To provide some assistance to schools that desire to infuse environmental content across the curriculum, the authors constructed a series of three tables that provide insight into the potential for infusion. A three-year scope and sequence appropriate for middle school students is illustrated. This

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range, from ages 10 to 15, was targeted because of cognitive maturation on the part of middle school students and the perception that the middle school curriculum is more flexible than the secondary school curriculum. The scope and sequence begins in year one with instruction focused on the science discipline of ecology (Table 1). Year two (Table 2) focuses on environmental science and environmental health. Year 3 (Table 3) completes the sequence by focusing on environmental issue analysis, investigation, and resolution. (A complete K-12 scope and sequence, though possible, is beyond the scope of this article.) Further, the concepts and skills presented within the scope and sequence are tersely communicated. A complete explication of a similar scope and sequence can be found in Hungerford, Volk, and Ramsey (1990).

It should be understood that these tables show possibilities only! Educational needs and opportunities will vary from school to school, and a given faculty may choose to infuse quite differently from what is shown in these tables.

TABLE 1. Middle School Infusion Possibilities for Year One: Ecological Foundations and Man as an Ecological Factor

Outline Topic	Science	Health	S.S.	Math	L.A.	H.E.	Agr.
I. What is ecology? What do ecologists do?							
A. Defining "ecology"	x						
B. The role of ecologists	x		x				x
II. Individuals, populations, and levels of organization in society	x						
III. The "ecosystem concept" developed							
A. Importance of the concept	x						
B. Local/regional ecosystems	x						
C. Components of ecosystems	x						x
D. Ecological niches	x						x
E. Competition . . .	x						x
F. Tolerance ranges . . .	x						x
IV. Energy and ecosystems							
A. The need for energy . . .	x					x	x
B. The sun as the source . . .	x					x	x
C. Green plants as the basis . . .	x						x
D. Energy losses . . .	x					x	x
E. Net primary productivity . .	x						x
V. Ecological succession . . .							
A. Succession as a natural phenomenon	x						x
B. Succession as an orderly phenomenon	x						
C. Major categories . . .	x						x
D. A comparison of stages	x						
VI. Populations and their dynamics							
VII. Man as an ecological factor							
A. Man as a powerful variable	x		x				x
B. Man as an eruptive population	x		x	x			
C. Consequences of eruptive human populations	x		x			x	x
D. Man and the world's soils			x				x
E. Man and the world's forests	x		x				x
F. Man and the world's wetlands	x		x				x
G. Man and the world's wildlife	x		x	x			
H. Critical considerations . . .	x		x				x

Notes: S.S. = Social Studies; L. A. = Language Arts; H. E. = Home Economics; Agr. = Agriculture

TABLE 2. Middle School Infusion Possibilities for Year Two: Environmental Science and Environmental Health

Outline Topic	Science	Health	S.S.	Math	L.A.	H.E.	Agr.
I. Man: His history of resource consumption							
A. Early Man: hunters/gatherers			x				
B. Agricultural societies	x		x				x
C. Industrial societies	x		x				
D. Relation of population . . .	x	x	x	x		x	x
II. Soils and allied problems							
A. A definition . . .	x						x
B. Man's dependency . . .	x						x
C. Soil formation	x						x
D. Soil erosion	x						x
E. The link between human population/soil erosion			x				x
F. Soil conservation strategies							x
III. Water and allied problems							
A. The world's water supply	x		x				
B. Renewing the water supply	x		x				
C. Problems with water resources	x		x				x
D. Management strategies	x		x				x
E. Water conservation	x		x			x	x
IV. Food production and hunger							
A. The food that feeds the world	x		x			x	x
B. Food chain energy losses . . .	x					x	x
C. Characteristics of agri. systems	x		x				x
D. World food problems	x	x	x			x	x
E. The green revolution	x						x
F. Unconventional food plants	x					x	x
G. Increasing utilization of fish	x					x	x
H. Sustainable agriculture			x				x
I. Responsibilities of the individual			x				x
V. Forest resources							
A. Importance	x		x				
B. Short-term vs. long-term benefits			x				
C. The world's forests			x				x
VI. Air pollution							
A. Sources of air pollution	x		x				
B. Major pollutants	x	x					
C. Impact on human health	x	x					
D. Acid precipitation	x	x					x
E. Indoor air pollution	x	x				x	
F. Ozone depletion	x	x				x	
VII. Water pollution							
A. Sources of surface pollution	x						x
B. Human diseases traced to . . .		x				x	
C. Oceanic pollution		x					
D. Groundwater pollution	x	x				x	x
E. Waste water treatment	x	x				x	

Notes: S.S. = Social Studies; L. A. = Language Arts; H. E. = Home Economics; Agr. = Agriculture

TABLE 2, Continued: Middle School Infusion Possibilities for Year Two: Environmental Science and Environmental Health

Outline Topic	Science	Health	S.S.	Math	L.A.	H.E.	Agr.
VIII. Noise pollution							
A. Sources and levels	x						
B. Effect of noise on humans	x	x				x	
C. Noise control	x	x	x			x	
IX. Solid waste disposal							
A. Solid waste defined		x				x	
B. Sources of solid waste		x				x	x
C. Sources of municipal waste		x				x	
D. Affluent/non affluent nations			x	x			
E. Methods of municipal waste disposal		x				x	
F. Source reduction of wastes	x		x			x	x
G. Issues re: solid waste management	x	x	x			x	x
H. The individual . . .			x			x	x
X. Hazardous waste							
A. Hazardous waste defined	x	x				x	x
B. Sources of hazardous waste	x					x	x
C. Hazardous waste disposal the past	x					x	x
D. Hazardous waste today	x					x	x
E. Issues surrounding hazardous waste disposal	x		x			x	x
F. The individual . . .			x			x	x
XI. Human population growth and control							
A. No population can sustain limitless growth	x			x		x	
B. Human population dynamics	x		x	x		x	
C. Age structure	x		x	x			
D. Issues associated with	x		x			x	x
E. Economic development and population changes			x	x		x	
F. Advantages of family planning combined with economic development		x	x			x	
G. Immigration and population dynamics			x				
H. Birth control and population dynamics		x				x	
I. Major issues . . .	x	x	x			x	

Notes: S.S. = Social Studies; L. A. = Language Arts; H. E. = Home Economics; Agr. = Agriculture

TABLE 3. Middle School Infusion Possibilities for Year Three: Issue Investigation and Citizenship Action Training

Outline Topic	Science	Health	S.S.	Math	L.A.	H.E.	Agr.
I. Environmental problem solving							
A. Human-environment interactions	x		x				
B. Quality of life vs. quality of the environment	x	x	x			x	x
C. Environmental problems and issues	x	x	x			x	x
D. Issue analysis	x	x	x			x	x
E. Examples of analyzed issues	x	x	x			x	x
F. Applying issue analysis skills	x	x	x			x	x
II. Identifying issues and preparing research questions							
A. Identifying environmental issues	x	x	x			x	x
B. Identifying variables associated with environmental issues	x		x				
C. Writing research questions	x		x		x		
III. Using secondary sources							
A. Secondary sources of issue-related information					x		
B. Processing information from secondary sources			x		x		
C. Reporting secondary source information					x		
IV. Using primary sources							
A. Surveys, questionnaires, and opinionnaires	x		x		x		
B. The interview					x		
C. Selecting populations & sampling	x		x	x			
D. Data collection strategies	x		x				
E. Developing and using instruments/ interviews	x	x	x		x	x	x
V. Interpreting data from environ. issue investigations							
A. Organizing data in data tables	x		x	x			
B. Communicating data by graphing	x		x	x			
C. Interpreting data	x		x		x		
D. Applying data-interpreting skills to	x	x	x			x	x
VI. The independent investigation of a student-selected environmental issue							
A. Selecting issues & research questions	x	x	x		x	x	x
B. Collecting secondary information			x		x		
C. Collecting primary information	x	x	x	x	x	x	x
D. Issue analysis/data interpretation	x		x	x	x		
E. Communication of results					x		
VII. Issue resolution: Skills and application							
A. Citizenship responses to issues	x	x	x			x	x
B. Principles of citizenship action			x				
C. Methods of citizenship action			x			x	x
D. Individual vs. group action		x	x			x	x
E. Guidelines for decision making	x	x	x			x	x
F. Applying issue-resolution skills		x	x	x		x	x

Notes: S.S. = Social Studies; L. A. = Language Arts; H. E. = Home Economics; Agr. = Agriculture

TABLE 4. Wisconsin's EE Curriculum Model

	Subgoals	
Grade-level range	**Major Emphasis**	**Minor Emphasis**
K-3	Awareness Attitudes and values	Knowledge Citizen action skills Citizen action experience
3-6	Knowledge Attitudes and values	Awareness Citizen action skills Citizen action experience
6-9	Knowledge Citizen action skills Attitudes and experience	Awareness Citizen action experience
9-12	Citizen action skills Citizen action experience Attitudes and experience	Awareness Knowledge

One Last Comment

It should be clear that there are many opportunities for environmental education in the middle school curriculum. What about EE in the primary and intermediate elementary grades? Again, there are just as many "windows" for infusion. A number of EE curriculum packages exist that were designed to supplement existing curriculum. Among these are Project Learning Tree, Project WILD-Elementary, and Nature Scope - all of which provide interdisciplinary activities and infusion ideas. What about the discipline-focused secondary school? Project WILD-Secondary is widely used as a curriculum supplement in high school science courses. Further, upper-level biology, chemistry, and physics courses present excellent opportunities for the infusion of teacher-developed case studies. For example, an acid rain case study (constructed in congruence with the EE goal hierarchy) might follow an "acids" unit in a chemistry course.

But thoughtful curriculum planners know that episodic treatments only in certain courses must be avoided. Environmental education must be systematically constructed and theoretically valid to achieve its goals. Wisconsin (Engelson 1989) has proposed the infusion framework displayed in Table 4 to ensure systemic planning for that state's curriculum planners.

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Integration and Curriculum Design

Trudi L. Volk

In this important reading, Dr. Volk details what it takes to produce a successful environmental education curriculum, if one wants to see changes in overt environmental behavior. In order to understand the complexities involved, she communicates what we know about what goes into responsible citizenship behavior and how these components would be reflected in a successful curriculum. In addition, she tells us how to evaluate existing curricula and what steps are needed as one plans for the successful implementation of new instructional programs.

Introduction

Designing an effective and comprehensive curriculum is a complicated and difficult task, even when the goals and objectives of a field are commonly agreed upon and accepted. As John Disinger points out . . . environmental education means many things to many people. This lack of agreement on the meaning of environmental education makes the discussion of curriculum design in this field more difficult.

The focus of this [reading], however, is curriculum design; and curriculum design cannot be discussed in a meaningful fashion if it is discussed in a vacuum. We must decide what this education is educating toward before we can plan how to get there. Therefore, with apologies to those who would argue other goals worthy of attention, this chapter will assume that environmental education is focused on the development of responsible individual and societal behavior, based on a consensus of past and current goal statements and definitions generated by environmental educators on the national and international levels (Engelson 1985; Engelson 1993; Environmental Protection Agency 1992; Hungerford, Peyton, and Wilke 1980; Stapp et al. 1969; UNESCO 1977).

Educating For Responsible Environmental Behavior

If responsible environmental behavior is the general goal for environmental education, what does this imply for education programs? In their synthesis of research on responsible environmental behavior, Hungerford and Volk (1990) recommended critical components for environmental education programs (table 1). These educational components should appear throughout a K-12 curriculum in a developmentally and instructionally appropriate manner. The following discussion is offered to familiarize the reader with these components and their importance to responsible environmental behavior.

> **Designing an effective and comprehensive curriculum is a complicated and difficult task . . .**

Ecological Literacy

Ecological literacy is important to sound environmental decision making. In order to approach issue resolution in an informed and responsible manner, the learner must be able to identify the ecological consequences related to the issues and to their proposed solutions. Thus, ecological concepts and principles must be in-cluded in the curriculum in a thorough and comprehensive manner. Throughout their formal education, learners should experience both classroom and field experiences centered on topics such as individuals and populations; interactions and interdependence; environmental influences and limiting factors; energy flow and nutrient cycling; community and ecosystem; homeostasis; succession; humans as members of ecosystems; and the ecological implications of

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Table 1. Critical Educational Components

It appears that we can maximize opportunities to *change learner behavior* in the environmental dimension if educational agencies will:

1. teach environmentally significant ecological concepts and the environmental interrelationships that exist within and between these concepts;

2. provide carefully designed and in-depth opportunities for learners to achieve some level of environmental sensitivity which will promote a desire to behave in appropriate ways;

3. provide a curriculum that will result in an in-depth knowledge of issues;

4. provide a curriculum that will teach learners the skills of issue analysis and investigation as well as provide the time needed for the application of these skills;

5. provide a curriculum that will teach learners the citizenship skills needed for issue remediation as well as the time needed for the application of these skills, and;

6. provide an instructional setting which will increase learners' expectancy of reinforcement for acting in responsible ways, i.e., attempt to develop an internal locus of control in learners.

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human activities and communities. Ballard and Pandya (1990) propose a well-constructed framework for organizing ecological concepts in *Essential Learnings in Environmental Education*. Their document comprises a database of basic concepts which research indicates to be necessary to form a solid understanding of the environment. Their sourcebook is designed to aid the educator in planning for instruction related to these concepts.

Ballard and Pandya (1990) help identify what to teach. An equally important consideration is how the content is to be taught. Wherever possible, the learner should be allowed and encouraged to engage in field experiences and observe the natural world and its interactions on a firsthand basis. At the early grade levels, the primary exploration should be of the immediate environment (community, ecosystem, biome). If one wishes learners to develop an understanding of layering in the forest, it is more effective to visit the oak-hickory forest nearby than to study about the exotic tropical rainforest thousands of miles away. Similarly, observing the energy exchanges present in a nearby pond makes more sense for a land-locked midwestern student than does studying about food chains and webs in the ocean. Conversely, children residing in a coastal community would be well served by the opportunity to make observations about those same phenomena at the seashore. As children mature and develop, lessons can include more remote and abstract ecological entities. These ideas will be better understood because of the direct experiences encountered at earlier grade levels.

In order to approach issue resolution in an informed and responsible manner, the learner must be able to identify the ecological consequences related to the issues and to their proposed solutions.

Environmental Sensitivity

Environmental sensitivity refers to an empathetic view of the environment and of its problems and issues. It is a view that respects ecological stability and promotes the idea that humans must live in harmony with the natural environment. Research indicates that environmental sensitivity is more prevalent among those who behave in environmentally responsible ways than among those who do not (Marcinkowski 1989; Sia, Hungerford, and Tomera 1986; Sivek and Hungerford 1990).

> **Environmental sensitivity can be particularly troublesome to many environmental educators who understand its importance.**

Environmental sensitivity can be particularly troublesome to many environmental educators who understand its importance. Why is this? Because the variables associated with sensitivity are not often those that are evident (or perhaps even feasible) in formal educational settings. Researchers who have focused on environmental sensitivity (Peters-Grant 1987; Peterson 1982; Scholl 1983; Tanner 1980) agree that environmentally sensitive individuals tend to participate in outdoor experiences, such as hiking, hunting, and fishing, with a relatively small number of close acquaintances and over an extended period of time. Due to budget cutbacks, many schools cannot afford residential camp experiences, or even field trips for students. However, wherever possible, schools should cooperate with informal organizations (outdoor and nature centers, youth groups, etc.) to provide outdoor experiences to students.

Fortunately, there are experiences that can promote environmental sensitivity which are often within the means of a school to provide. Whenever possible, learners should be permitted and encouraged to take part in outdoor experiences such as gardening, establishing a nature walk or other natural area, and even reclaiming a deteriorated natural area. These experiences can take place on or near the school grounds and can be both educational and recreational. In this way, many of the ecological concepts and principles to be taught can be enhanced through outdoor experiences.

Research on environmental sensitivity also indicates that books, video-tapes, music, and other materials can give learners a positive attitude toward the environment. Similarly, environment-related works of nature photographers, wildlife artists, and musicians would probably encourage sensitivity in a number of individuals.

Many learners also respond well to role models of environmental sensitivity. Such models can be found in biographies of individuals whose lives were devoted to the environment and nature (e.g., Rachel Carson, Anna Comstock, Ding Darling, Jane Goodall, Aldo Leopold, John Muir). Yet another (and perhaps stronger) inspiration for environmental sensitivity could be the classroom teacher or youth learner who has an empathetic and concerned perspective toward the environment.

In-Depth Knowledge of Issues

Over the course of the primary years, students should become knowledgeable about a large array of environmental issues. Ideally, these issues would be local in nature at the early years, and expand into more regional, national, and international concerns at succeeding grade levels. In addition, as learners grow older, their information about issues should increase in depth and quality.

> **An in-depth knowledge of environmental issues includes more than learning about a variety of issues. It also includes considering the consequences and implications of those issues.**

An in-depth knowledge of environmental issues includes more than learning about a variety of issues. It also includes considering the consequences and implications of those issues. Thus students should understand how their individual behaviors impact the environment. Similarly, they should conceptualize how human behaviors, on a collective basis, affect the environment. They should also begin to see that many human behaviors are influenced by societal concerns such as politics, economics, religion, human health and safety, ethics and morals, and so on.

In-depth issue knowledge also includes understanding the difference between environmental problems and environmental issues, and the relationship between beliefs, values, and issues. An environmental *problem* is a threat or difficulty related to the environment. An environmental *issue* arises when individuals or groups disagree that there is a problem or disagree about what should be done about the problem. Differing beliefs and values are what drive issues. The issue may pit economic interests against ecological interests or political interests against health and safety concerns. Of course, many times, an array of differing beliefs and values are involved within any one issue.

In-depth issue knowledge is primarily conceptual, but it suggests an important skill component. That component is issue analysis, which includes the abilities to identify environmental problems and issues; recognize the groups or players involved in the issue and the positions taken by those players; state beliefs communicated by those players; and infer the values which appear to underlie those beliefs. This set of skills enables learners to analyze and understand the complex nature of issues.

> **An environmental *issue* arises when individuals or groups disagree that there is a problem or disagree about what should be done about the problem.**

Issue Investigation Skills

Research indicates that responsible citizen behavior is enhanced when students become actively involved in the investigation of environmental issues (Holt 1988; Klingler 1980; Ramsey and Hungerford 1989; Ramsey, Hungerford, and Tomera 1981). In order to do this, they must develop problem-solving skills as well as information-accessing and -processing skills. Learners also need to develop decision-making skills as they identify and evaluate the environmental and sociocultural implications of issues and alternative solutions. Many educators believe that learners need to apply and practice these skills in order to best learn, retain, and use them. Briefly, these skills include:

- generating research questions
- accessing information from print and other resources
- comparing information from a variety of sources for bias
- synthesizing information from a variety of sources
- developing research questions
- designing and conducting surveys
- collecting data
- generating data-based conclusions, inferences, and recommendations
- interpreting and communicating data
- evaluating alternative solutions and their consequences

At earlier grade levels, student investigations can take the form of teacher-led group inquiries into local issues. As the students progress through the grade levels and become more capable of and skilled in analysis, synthesis, and evaluation, they will be able to take more control over decisions related to the issues to be investigated and to the actual issue investigation.

Citizenship Skills

Citizenship skills are those skills that individuals can use to help solve environmental issues. Knowing what these skills are and how to practice them is an important contributor to responsible environmental behavior (Holt 1988; Klingler 1980; Ramsey and Hungerford 1989; Ramsey, Hungerford, and Tomera 1981; Simpson 1989). Once learners have made decisions regarding the most appropriate solutions to environmental issues, they need to consider how to work toward those solutions. Just like the skills needed to investigate and evaluate issues, citizen action skills are better learned and retained when opportunities are provided for practice and application. Ideally, this application occurs after an in-depth investigation and evaluation of an issue and its alternative solutions. Citizen action skills include major methods of citizenship participation available to individuals:

- **ecomanagement** or physical action - a physical action taken to help improve the status of an issue (e.g., picking up litter, building wood duck boxes, planting sea oats on dunes)
- **persuasion** - the act of trying to convince a person or group of persons that a certain action is correct (e.g., writing letters to the editor, a persuasive speech, an ad campaign)
- **consumer action** - the act of buying (or not buying) a product or service; relies on economic power to support (or not support) certain ideas held by producers, manufacturers, agencies, legislatures, or nations (e.g., consumer boycotts, reduced use of products)

> **. . . it is critical that students learn how to make good decisions about solving environmental issues.**

- **political action** - an action that brings pressure on political and government agencies and their representatives in order to persuade them to take a certain action (e.g., lobbying, campaigning for a political candidate, letter writing to elected officials)

- **legal action** - an action that uses the legal system to bring about a certain solution to an issue (e.g., court orders, lawsuits, injunctions)

Citizenship skills also enable students to analyze the effectiveness of individual versus group action, develop issue-resolution plans that incorporate one or more of the five types of citizen action, and evaluate those plans in terms of social, cultural, and ecological consequences and implications.

It is important for students to understand how they can help to solve environmental issues. Because issues change over time, and because appropriate solutions also change, it is critical that students learn how to make good decisions about solving environmental issues. Responsible decision making is refined as students formulate action plans and evaluate the environmental and sociocultural implications of those plans. Although no demand should be made that the student take action, educators should provide support and encouragement for students who wish to implement their action plans.

Internal Locus of Control

Research tells us that an important factor in whether an individual will engage in environmentally responsible behavior is that person's *locus of control*, or feeling of effectiveness (Hines et al. 1987; Sia, Hungerford, and Tomera 1986; Sivek and Hungerford 1990; Marcinkowski 1989). A person with an internal locus of control feels that s/he has a measure of control over events which occur. A person with an external locus of control believes that control over what happens is beyond his or her grasp. An individual who believes that s/he is powerless to make changes in society probably will not act in a citizenship dimension.

Locus of control may be influenced when a student learns and applies citizenship action skills. More specifically, locus of control may become more internal when students have had an opportunity to apply these skills successfully in the community.

The first step in establishing the direction of the curriculum is to identify goals.

Planning Your Environmental Education Curriculum

What are the actual steps in the process of curriculum development for environmental education? Curriculum development might be undertaken for a single course, for a specific grade level, or for a range of grade levels. This section will focus on curriculum development, across a range of grade levels, undertaken within a school district. Curriculum development in other situations is similar, but will vary in scope and range.

A number of authorities suggest guidelines for developing curriculum. In *Procedures for Developing an Environmental Education Curriculum* (prepared for distribution by the United Nations Environmental Programme), Hungerford and Peyton (1986) discuss specific steps in the development of curriculum for environmental education. Their suggested components for the curriculum development process provide the framework for the following discussion. The process can be modified to fit the specific needs of a particular school, district, or region.

Organize a Curriculum Development Team

The initial step in curriculum development is identifying who has a decision-making role. Given the number of individuals and groups who are stakeholders in environmental education, a committee approach is the best vehicle to assure the later approval and acceptance of the curriculum. Two key subgroups would compose this committee: a core team and a support team

The core team would have the major responsibility for curriculum development. Care should be taken to ensure that this team represents the range of discipline areas and grade levels which eventually might be affected by the curriculum. Members of the core team would include content area representatives, generalists (especially elementary teachers), an environmental education coordinator (ideally, an accomplished classroom teacher with training, experience, and interest in environmental education), and representatives of the administration.

Initial tasks of the curriculum development committee would include establishing tasks and timelines for the two teams; identifying liaison procedures to be used between the teams; collecting appropriate resources, such as curriculum materials and professional references; and identifying constraints which might impinge on the curriculum development effort and planning for their resolution.

The role of the support team is to support the efforts of the core team. Members of this team would be chosen for their expertise and assistance in relation to specific tasks in curriculum development. Thus the support team might include curriculum development specialists, environmental education specialists, environmental scientists, appropriate community representatives, and program evaluation specialists.

Identify Goals for Your Environmental Education Curriculum

The first step in establishing the direction of the curriculum is to identify goals. [One set of goals for curriculum development (Hungerford, Peyton, and Wilke (1980)) can be found elsewhere in this book of readings.] These goals . . . contain four goal levels with related subgoals. They were written specifically to guide curriculum development in environmental education, and will serve to illustrate various steps in the process of curriculum development. These goals are generally considered to represent a consensus of what authorities in environmental education believe to be goals of the field. They are also consistent with the development of responsible citizen behavior.

A particular district may wish to utilize these goals as they are, to adapt them to reflect the local educational philosophy, or to develop a different set of goals. As the committee approaches this decision, it may wish to consult a number of the professional documents collected earlier, as well as its own state educational framework. Those documents might include literature on aims, goals, and purposes of environmental education . . . ; samples of environmental education curriculum; references on ecology and environmental science; information on local, regional, national, and international environmental issues; literature on learning theory and instructional models; and references on curriculum development, implementation, and evaluation.

The task of identifying or selecting the goals which will guide the curriculum is no small task. The goals that are ultimately adopted will reflect the committee's philosophy about education in general and about environmental education in particular. Once general goals have been established, they can be refined into an integrated system of subgoals and objectives. Curriculum materials, teaching strategies, and classroom activities are then selected using these objectives.

Develop the Scope and Sequence of the Curriculum

The scope relates to the extent of coverage within the curriculum in terms of objectives (cognitive, affective, and psychomotor). Scope might also refer to the breadth of coverage given to ideas or conceptual schemes. Sequence refers to the assignment of these elements to grade levels based on a hierarchy of concepts, skills, and attitudes. The development of the scope and sequence is a critical activity, since it will provide direction for the subsequent selection and development of curriculum materials. In developing the scope and sequence, it may be best to proceed through the following steps:

1. Develop the curriculum's scope by expanding the separate subgoals within each goal level into objectives.
2. Assign these objectives to appropriate grade levels.
3. Assign the objectives within grade levels to appropriate discipline or content areas.

Scope

Developing the scope involves expanding the goals and subgoals into objectives. In essence, the curriculum developer is breaking down the goals into components which can be accomplished. This process involves examining your goals, rephrasing each goal into several subgoals, and then identifying objectives which would accomplish each of those subgoals. Table 2 illustrates the relationship between goals, subgoals, and objectives in developing the scope.

Once the scope of the curriculum has been developed, it must be sequenced into grade levels. Developing the grade level sequence of the curriculum is a difficult task. It would be helpful to work with a curriculum development specialist at this point. Consulting other effectively designed environmental education curriculum projects may also prove valuable.

The development of the scope and sequence is a critical activity, since it will provide direction for the subsequent selection and development of curriculum materials.

Sequence

Decisions about sequencing the objectives may be related to a hierarchy inherent within the objectives. For example, elementary concepts of ecology should be introduced before students attempt to understand what an environmental issue is. Similarly, teaching students how to investigate environmental issues would occur before they undertake their own issue investigations. The same holds true for other areas.

Another important consideration in developing the sequence is the application of learning theory. For example, Jean Piaget's theory of development maintains that learners proceed through developmental stages. Thus, certain components of the scope may be more appropriate for some learners than for others. For example, considering and evaluating alternative solutions to environmental problems may be beyond the ability level of a concrete thinker in the primary grades and be more appropriate for older students capable of developing formal thought patterns.

Horizontal Organization

A further refinement in scope and sequence involves the assigning of the scope components to appropriate disciplines within each grade level. For this task, the committee must use its combined expertise to determine how the environmental education objectives are related to other disciplines in the curriculum and where they might be more efficiently and effectively accomplished. Each of the content specialists on the team will be familiar with teaching approaches, materials, and objectives in his or her own disciplines, and thus should be able to identify points at which objectives in the infused discipline may parallel, complement, or supplement environmental education objectives. In assigning objectives to appropriate subjects within grade levels, it may be useful to consider a number of the following questions.

How often should environmental education (EE) objectives be reinforced throughout the curriculum? Repetition can enhance the acquisition or transfer of knowledge, intellectual skills, and attitudes. The more complex these components are, the greater the need for their inclusion at several points throughout the curriculum. The knowledge, intellectual skills, and attitudes involved in the investigation of environmental issues should be infused into several disciplines at all grade levels (with increasing frequency and depth at higher levels of education). A particularly effective strategy in curriculum design is the "spiral approach." In this design, concepts, cognitive skills, and attitudes may be spiraled vertically through the curriculum, increasing depth and complexity with successive exposures.

How can infusion be accomplished to maximize the use of existing facilities and expertise? Because of its interdisciplinary nature, environmental education lends itself well to an infusion approach. According to Ramsey, Hungerford, and Volk, "infusion refers to the integration of content and skills into existing courses in a manner as to focus on that content (and/or skills) without jeopardizing the integrity of the courses themselves" (1992, 40). In planning for infusion, the committee should carefully analyze existing courses in order to identify opportunities to incorporate environmental education topics and skills. For example, objectives concerned with the knowledge and skills of persuasive action may best be assigned to subject areas taught by teachers with training in communication. Other decisions for this type of organization may be made based on opportunities for effective team teaching. Ramsey, Hungerford, and Volk (1992) identify important topics and skills in environmental education and infusion possibilities within the major subject areas (table 3).

Another helpful guide to infusion is *Avoiding Infusion Confusion* (Hayden et al. 1987). This set of handbooks for grades K-3, 3-6, 6-9, and 9-12 identifies activities from selected widely used environmental education programs which are appropriate for developing environmental education goals. The series uses the Wisconsin environmental education curriculum framework in the analysis, and suggests infusion possibilities into art, health, language arts, science, and social studies.

[Developing the scope] involves examining your goals, rephrasing each goal into several subgoals, and then identifying objectives which would accomplish each of those subgoals.

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Table 2

Selected Objectives to Illustrate the Development of Scope at Four Curriculum Development Goal Levels

The examples of objectives are intended to show the specific nature of a partially developed curriculum scope based on goal levels of the Goals for Curriculum Development in Environmental Education.

Goal Level I. Ecological Foundation Level: sufficient ecological knowledge to make ecologically sound decisions.

Subgoal B: Interactions and interdependence.

Sample Objectives: students will be expected to be able to:

- give a description of a population interaction in a community, identify the interaction as predator - prey, competition, or mutualism.
- explain how organisms compete within an ecosystem, and provide two valid examples.
- distinguish between competition within a species and competition between species, and provide two examples of each.

Goal Level II. Conceptual Awareness Level - Issues and Values: how individual and collective actions influence quality of life and quality of the environment.

Subgoal A: How human cultural activities influence the environment.

Sample Objectives: students will be expected to be able to:

- communicate a definition of "sustainable development."
- list at least three interactions that take place between human beings and their environment

  which could interfere with the goal of sustainable development.

Subgoal F: The roles played by differing human values in issues.

Sample Objective: students will be expected to be able to:

- (after reading several articles on an environmental issue) identify the major players involved in this issue, the players' positions on the issue, the players' beliefs

  related to this issue, and the values associated with these beliefs and positions.

Table 2 (Continued)

Goal Level III. Investigation and Evaluation Level: knowledge and skills necessary to investigate and evaluate issues and solutions.

Subgoal A: Knowledge and skills to identify and investigate issues and synthesize the gathered information.

Sample Objectives: students will be expected to be able to:

- identify governmental or private agencies to which they can write for specific information about an environmental issue.
- write a sample letter to an agency asking for information about a particular environmental issue. [The letter is to be correct in terms of its general structure, agency chosen to be contacted, and the kind of information requested.]
- identify one or more local (or regional) issues which impact upon sustainable development and which could be investigated with the use of a questionnaire.

Goal Level IV. Environmental Action Skills Level - Training and Application: skills necessary to take positive environmental action.

Subgoal A: Develop those skills which ... permit them to take individual or group action when appropriate.

Sample Objectives: students will be expected to be able to:

- produce an example of an effective persuasive action on some issue which combines both logical and emotional reasons for taking action and follows appropriate guidelines for persuasive action.
- describe the dangers of persuasive actions based only on emotion and give one example of an actual environmental issue in which such actions were taken.

Source: Adapted from H. R. Hungerford and R. B. Peyton, *Procedures for Developing an Environmental Education Curriculum* (Paris: UNESCO-UNEP International Environmental Education Programme, 1986), 50-51.

Faculty members are the key to successfully infusing environmental education into the curriculum. A comprehensive infusion strategy demands a great deal of cooperation from the teachers who will be responsible for the infused program. Teachers must be in favor of an infused environmental education curriculum, and they must be willing to work cooperatively to build a plan for infusion and to see that the plan is carried out. It is important that instruction proceed logically across content areas; therefore, a major effort must be made to respect the integrity of the scope and sequence of existing courses. This can be accomplished by communication between teachers working independently or by elementary teachers in self-contained classrooms. Perhaps a better approach at the secondary level

Table 3

Environmental Education Topics and Skills: An Infusion Inventory

The Skill	Science	Social Studies	Math	Language Arts
Environmental Sensitivity	X			X
Ecological Concepts	X			
Environmental Issue Information	X	X		X
Environmental Implications	X	X		
Socio-Cultural Implications		X		
Human Beliefs/Values		X		X
Examining Values		X		
Issue Analysis	X	X	X	
Identifying Problems/Issues	X	X		X
Accessing Secondary Information	X	X		X
Evaluating Information for Bias	X	X		X
Synthesizing Information		X		X
Writing Research Questions	X	X	X	X
Developing Survey Instruments	X	X	X	
Conducting Interviews		X		X
Sampling	X	X	X	
Collecting Data	X	X	X	
Recording/Organizing Data	X	X	X	
Graphing	X	X	X	
Data Interpretation	X	X	X	
Communication (Written)	X	X	X	X
Communication (Oral)	X	X	X	X
Citizenship Action Skills				
Consumer Action		X		
Political Action		X		
Persuasion		X		X
Ecomanagement	X	X		
Action Analysis/Evaluation	X	X		

Source: Adapted from J. R. Ramsey, H. R. Hungerford, and T.L Volk, (1992), "Environmental Education in the K-12 Curriculum: Finding a Niche" *Journal of Environmental Education* 23(2), 44.

involves team teaching with instructors from two or more content areas working cooperatively to deliver thoughtful instruction.

If time and other resources permit, it would be advantageous to train faculty members in infusion techniques and provide them with time to plan for the infusion of environmental content and skills. This strategy would allow the faculty members to identify barriers to infusion and develop strategies for removing these barriers.

The alternative to an infusion approach is to treat environmental education as a single (interdisciplinary) subject. Advantages for dealing with environmental education in this manner include that the integrity of the scope and sequence of the environmental education curriculum itself would be better assured; that fewer teachers would need to be trained in environmental education content, skills, and methodology; and that the need for wrestling with infusion problems would be lessened. However, there are also some disadvantages. One marked disadvantage lies in not being able to use other content areas as vehicles for promoting the knowledge and skills in this scope and sequence. Language arts, social studies, science, home economics, health, agriculture, and other courses are ideal vehicles for infusing environmental content without threatening course integrity.

Are the EE objectives more appropriate for a multidisciplinary (infusion) model or interdisciplinary (single subject) model? Single subject or infusion? Hungerford and Peyton (1986) present a comparison of the two approaches, identifying the major advantages and disadvantages of each. In all likelihood, the most effective treatment of environmental education would incorporate a judicious mix of both approaches. It is likely that the primary and intermediate grade levels would be better served by the infusion approach. The most common pattern at these levels is that of the self-contained classroom, with a single instructor responsible for all subjects. In such a setting, the infusion approach could be optimally utilized.

At the middle and secondary levels, a separate course on the environment and environmental issues might be appropriate. This is probably an effective and efficient vehicle to provide an interdisciplinary experience to accomplish certain environmental education objectives. Because of the interdisciplinary nature of environmental education, the middle grade level would probably be an ideal place for such a course. At this level, most learners would be at a developmental stage wherein they could master the problem-solving, decision-making, and citizen-participation skills inherent in environmental education. Once these skills have been mastered, subsequent courses could offer students opportunities to apply them to a wide variety of issues (see table 4).

Such a sequence of courses would seem likely to enhance both the acquisition of important citizenship qualities as well as their transfer. That is, it appears likely that the learners could acquire the knowledge, attitudes, and skills associated with ownership and empowerment in the courses, and would be able to transfer those learnings to situations throughout their lives.

How can environmental education objectives be infused into the curriculum so that principles of acquisition and transfer are attended to and learners are able to synthesize their experiences in various disciplines into a meaningful environmental education context? The infusion process must not isolate objectives of environmental education so extensively throughout the curriculum that this synthesis does not take place. This implies careful planning and an effective curriculum articulation both vertically (through grade levels) and horizontally (assignment to subject areas). An articulated curriculum across the primary grades and through secondary school is crucial. In Wisconsin's *Guide to Curriculum Planning in Environmental Education*, Engelson (1993) identifies five subgoals of environmental education: awareness, knowledge, attitudes and values, citizen-action skills, and citizen-action experience. Using these subgoals and research on human growth and development, Engelson suggests a changing degree of emphasis on each subgoal category across K-12 grade levels. Engelson's subgoals are similar to those developed by Hungerford, Peyton, and Wilke (1980). Adapting his analysis to incorporate the Hungerford, Peyton, and Wilke goals (along with the prerequisite goal of sensitivity) yields the configuration found in table 5.

Since environmental education goals are hierarchical in nature, it is wise to incorporate them throughout the curriculum in a hierarchical fashion. Thus, at the earlier grade levels, the emphasis is on sensitivity, knowledge, and concepts. At increasing levels of learner ability and sophistication, skills (including both investigation and evaluation and citizen-action skills) are introduced and developed, and opportunities are provided so that students can apply skills to actual environmental issues and solutions.

An important consideration in teaching for environmentally responsible behavior is that of reinforcement. Instruction focused on issue investigation and resolution does increase learner involvement in environmentally positive behavior. However, if this behavior is not reinforced and supported, it erodes as time passes. How can that support be provided? Ideally, by involving learners in environmental issues and their resolution beginning in the early grades and continuing throughout their formal schooling.

The issues addressed in the early grades would be ones of local significance upon which learners could have a positive impact. With succeeding grade levels, learners could address issues with greater complexity and scope (e.g., the issues should include regional, national, and international issues as well as local ones). Similarly, the involvement of students would increase relative to their abilities; that is, at the early grades, students would participate in teacher-led class projects (issue investigations and action plans), whereas students at the upper elementary and secondary levels would initiate individual or small group investigations and action plans.

The issues addressed in the early grades would be ones of local significance upon which learners could have a positive impact. With succeeding grade levels, learners could address issues with greater complexity and scope . . .

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Table 4

Interdisciplinary vs. Multidisciplinary (Infusion) Formats for EE: Advantages and Disadvantages

Considerations	Interdisciplinary Characteristics (Single Subject)	Multidisciplinary Characteristics (Infusion Strategy)
1. Ease of Implementation	Easier to implement as a single subject [in the curriculum] if time permits; teacher training is less of a problem.	Requires that more teachers be trained; greater coordination of curriculum necessary; requires less time/content in the existing curriculum.
2. Teacher Competencies	May require fewer teachers but with more in-depth training in EE; thus teacher training is less demanding in terms of teacher numbers but more demanding in terms of level of competencies required.	Requires that teachers of all disciplines be competent to adapt and/or use EE materials, although perhaps not to the same depth as in single subject approaches.
3. Demand on Curriculum Load	Requires addition of this discipline to an already crowded curriculum.	May be effectively implemented with minimal demands on existing curricular load.
4. Ease of Curriculum Development	Components easier to identify and sequence.	Components must be effectively identified, sequenced, and accommodated by the existing curriculum.
5. Evaluation	A comprehensive evaluation is much easier to accomplish in a single-subject curriculum.	Comprehensive evaluation difficult due to the number of variables involved.
6. Age-Level Appropriateness	May be more appropriate at secondary than elementary levels. For some types of EE goals, may be essential at secondary and tertiary levels.	Appropriate at all age levels with some exceptions at secondary and tertiary levels.
7. Effectiveness in Teaching for Transfer	More difficult to use in effectively teaching for transfer. Requires special efforts to do so.	Teaching for transfer is inherent in this approach when properly used. Infusion permits decision-making to take place in other disciplines in an environmental context.
8. Ability to Provide In-Depth Coverage of Environmental Issues	Budget consideration entirely dependent on the nature of the course being developed. A highly sophisticated course demanding many field excursions or laboratory equipment could prove costly.	Monetary considerations very dependent on the nature of the curriculum being developed. Monies required could be greater than in a single subject curriculum due to numbers of learners involved across numerous grade (age) levels.

Source: H. R. Hungerford and R. B. Peyton, Procedures for Developing an Environmental Curriculum (Paris: UNESCO-UNEP International Environmental Education Programme, 1986). 14.

Evaluate the Existing Curriculum

Once goals and objectives for environmental education have been identified and decisions made relative to scope and sequence, the committee should initiate an analysis of the existing program. This analysis should focus on identifying and evaluating existing curricular components (e.g., materials and activities) which might achieve environmental education objectives or which could be modified to accommodate those objectives. This phase should also identify specific needs for new environmental education materials and activities to be adapted or developed and infused into the program. Key questions which might facilitate this evaluation follow.

Table 5

Grade Level Emphasis on Environmental Education Goals

Grade Level Ranges	Major Emphasis	Minor Emphasis
K-3	Sensitivity Ecological foundations	Issues/values Investigation/evaluation Action skills
3-6	Ecological foundations Issues/values	Sensitivity
6-9	Ecological foundations Issues/values Investigations/evaluation Action skills	Sensitivity
9-12	Issues/values Investigation/evaluation Action skills	Sensitivity Ecological foundations

Source: Adapted from D. C. Engleson, *A Guide to Curriculum Planning in Environmental Education* (Madison, WI: Wisconsin Department of Public Instruction, 1993).

How can existing disciplines be used to accomplish environmental education objectives? Many parts of the existing curriculum may already be accomplishing the goals and objectives identified. For example, the objectives of a geography unit to provide learners with a knowledge of limited water resources throughout the world may be entirely consistent with the objectives identified in the environmental education curriculum. Objectives in math to provide learners with graphing skills may accommodate environmental education objectives if the data presented for the graphing activity illustrate human population trends throughout the world (or other appropriate data). Other situations will be identified where existing objectives (and teaching materials) may be "environmentalized" to allow needs of both curricula to be met.

An excellent vehicle for evaluating the existing curriculum can be found in the Environmental *Education Curriculum Inventory* by Ron [J. Ronald] Gardella (1993). Gardella developed a relatively simple instrument for assessing the extent to which materials (instructional units, samplers, curriculum guides) addressed each of the four environmental education goal levels found in the Appendix. By using the inventory, one can create a fairly accurate picture of the strengths and weaknesses of an existing curriculum. The inventory can also provide direction for supplementing the curriculum with existing materials or for developing new materials.

How can environmental education objectives be used to accomplish the objectives of the existing curriculum? A careful examination of environmental education objectives and the objectives of the traditional discipline areas should reveal considerable agreement. Table 3 illustrates the interdisciplinary nature of environmental education in terms of content and skills. Many times, objectives for the traditional subject areas are similar to environmental education objectives in relation to content and skills. In those cases, it would be relatively simple to approach those objectives within an environmental context. For example, an investigation of an environmental problem (e.g., dwindling fisheries or the loss of timber resources) could be used to develop or reinforce the application of communication skills, math skills, and knowledge from several other disciplines.

Inventory and Evaluate Available Resources

Subsequent to an inventory of what is available for use or already in place in the existing program, the development committee should identify supplemental instructional materials which might strengthen the program. As discussed earlier, many teaching activities have been developed to achieve environmental education objectives. Some of the curriculum needs may be accommodated by adapting these materials so they reflect a local emphasis and are consistent with the philosophy, scope, and sequence of the environmental education program being developed. Again, it is recommended that Gardella's *Environmental Education Curriculum Inventory* be used in this analysis.

Another type of inventory and evaluation is called for if the environmental education curriculum is to make the most of local and regional resources. This is an inventory and evaluation of available community and regional resources which can supplement the curriculum. These resources may include sewage treatment plants, land use management projects, ecosystems, or situations reflecting specific environmental issues (e.g., urban sprawl, landfill areas, desertification, erosion, channelization projects, wetland management problems, water pollution sites).

During resource inventory, each potential resource should be identified and annotated as to its description, availability, limitations of use

Table 6
Teacher Preparation Guidelines

Teacher preparation in environmental education should:

1. focus on and reflect the multifaceted and interdisciplinary nature of environmental education. In so doing, teachers should be provided with opportunities to acquire and apply the knowledge, skills, and attitudes important in environmental education. At the very minimum, this preparation should include:

   a. basic training in ecology.
   b. field and/or laboratory experiences for teachers in the area of environmental science.
   c. knowledge of environmental issues and problems of resource management.
   d. competencies in environmental problem identification, issue analysis, issue investigation and evaluation, and citizenship action.
   e. opportunities to develop value-clarification skills and knowledge of the roles of human values in environmental issues.

2. provide instruction and experience with multidisciplinary (infusion) curriculum as well as instructional activities and methods similar to those they might use in their own classrooms.

3. provide instruction on the philosophy and goals of environmental education and the nature of interdisciplinary and multidisciplinary (infused) environmental education curricula. Further, teachers should be trained in the implementation of these models.

4. provide specific training - particularly at the elementary level - in basic general education skills, e.g., in language arts, reading, and mathematics.

5. provide opportunities for teachers to develop skills in identifying, inventorying, and evaluating local resource for use in environmental education.

Source: Adapted from H. R. Hungerford and R. B. Peyton, *Procedures for Developing an Environmental Education Curriculum* (Paris: UNESCO-UNEP International Environmental Education Programme, 1986).

(seasonal usage, number of students permitted, cost involved, distances), and application to the environmental education curriculum. In addition, these resources should be classified or annotated with respect to appropriate program objectives and suggestions for use. The final form of this inventory may be a card file, computer program, or resource manual which can be used by writing teams that develop environmental materials. The resource inventory should also be available to all instructors.

Prepare the Environmental Education Curriculum

So far, the focus has been on the analysis of existing curriculum and of environmental education materials. The committee should have an accurate assessment of the gaps or weaknesses in the existing curriculum and of what materials are available. The final phase of curriculum development involves adapting existing materials or creating new materials to fill the gaps and strengthen the curriculum. If this appears to be a major task, it may call for the formation of a writing team or teams. The team should include a fair representation of grade levels and appropriate members of the support team (e.g., curriculum development specialists, environmental education specialists, environmental scientists). District subject-matter specialists (social studies, language arts, reading) would also be good candidates for this team. Take care that all members of the team understand the environmental education goals and the district's scope and sequence. The result should be a curriculum designed to accomplish the goals of environmental education.

Providing Environmental Education In-Service

Teachers are an important key to the success of the environmental education curriculum. It is critical that they themselves possess the knowledge, cognitive skills, and affective attributes (environmental sensitivity, internal locus of control) that they are expected to help students develop. As the time approaches for implementing the environmental education curriculum, teachers who lack the expertise to be effective environmental educators must be provided with opportunities to acquire these attributes. They must not only acquire these attributes, but do so in a manner that encourages them to transfer environmental education knowledge, skills, and attitudes to their students. Table 6 presents a set of guidelines, adapted from Hungerford and Peyton (1986) for the development of in-service programs in environmental education.

Develop Plans for Implementation

The exact nature of the implementation process will vary according to the educational structure and character of the school district and region. In addition, implementation will be affected by the nature of the curriculum program itself. Hungerford and Peyton (1986) have identified several variables that are associated with implementation and that probably contribute to a program's eventual success or failure. When thinking about implementing the curriculum, consider all three categories. Be sure to attend to these variables before it is time to implement the curriculum. That way, the stage will be set for smooth curriculum implementation, with acceptance and support from all who have a stake in education.

- Program approval by in-school vested interest groups:
  administration
  instructional supervisors
  teachers
  other support personnel
  student population

- Program approval by outside vested interest groups. These groups must be brought into the implementation process in order to assure their support and approval:

  accreditation agencies
  regional, state, and national education offices
  parent groups
  community leadership groups
  labor, business, and professional groups

- Critical concomitant variables. Concomitant variables found both within and beyond the school must also be considered. These variables will vary with the nature of the program itself and the specific characteristics of the school, region, or nation in which the implementation process takes place. [Concomitant variables] might generally include:

  scheduling and time constraints
  program coordination
  initial and ongoing in-service teacher education
  adequacy of facilities
  nature of local and regional resources
  appropriateness and adequacy of materials and equipment
  budget considerations

Develop a Comprehensive Evaluation Program

In today's educational systems, curriculum evaluation consists mostly of observations toward assessing how well students meet particular objectives or sets of objectives. Although this is one facet of curriculum or product evaluation, it is only a small part of what should be included in the total evaluation process. Also included should be an evaluation of the effectiveness of the curriculum (to determine whether the curriculum itself is in need of revision), an evaluation of the curricular materials, and an evaluation of those who are responsible for teaching the curriculum.

Appendix

Environmental Education Curriculum Inventory

Directions: Indicate how well the inventoried materials will help students to know about or accomplish the goal statements for each goal level by circling the appropriate number for each goal statement according to the scale below. Compute the Goal Average as directed.

Evaluation Scale:	Not at all	Poorly	Slightly	Fairly Well	Very Well
	0	1	2	3	4

Goal Level 1. Ecological Foundations

1. Populations: The nature/behavior of natural populations (birth, growth, change and its effects, death, extinction, etc.).	0	1	2	3	4
2. Natural Communities: Structure, behavior, interaction of individuals and populations in a particular place (forest, desert, sea, pond, etc.; food-chain, food-web, predation, etc.).	0	1	2	3	4
3. Ecosystems: Structure, interaction and effects between things and the non-living environment (natural change, succession, adaptation, etc.).	0	1	2	3	4
4. Energy and Chemical Cycles: How energy and chemicals go through a natural system (water cycle, oxygen cycle, energy cycle, pollutants, etc.).	0	1	2	3	4
5. Balance of Nature: The tendency of natural systems to establish balance over time when disturbed naturally or by human pollution.	0	1	2	3	4
6. Man as a Component of the Natural Systems: The effect of human behavior on natural systems (development of technology, effects of people's attitudes and values).	0	1	2	3	4

Ecological Foundations Total: Add all circled numbers.
Ecological Foundations Average:
Divide Ecological Foundations Total by 6...... _______________

Goal Level 2. Issues and Values

7. Identify the difference or discriminate between an environmental problem and an environmental issue. (Environmental problems may be natural or man-made, while issues are the conflict arising from how people view the problem.).	0	1	2	3	4
8. Communicate the way people's cultural activities affect the environment (politics, society, religion, etc.).	0	1	2	3	4
9. Communicate the way individual people affect the environment (individual actions and behavior).	0	1	2	3	4
10. Identify (clarify) his/her own attitudes and values toward an issue or the environment.	0	1	2	3	4
11. Communicate that there may be more than one way to resolve an environmental issue.	0	1	2	3	4
12. Communicate that the difficulty in resolving environmental issues is due to the different attitudes and values of the people involved in them.	0	1	2	3	4

Issues and Values Total: Add all circled numbers.
Issues and Values Average: Divide Issues and Values Total by 6. .... _______________

Goal Level 3. Investigation and Evaluation

13. Uses problem-solving skills to identify specific environmental problems and related issues.	0	1	2	3	4
14. Identifies the people (actors) involved in an environmental issue.	0	1	2	3	4
15. Identifies the beliefs and values that explain people's positions on an environmental issue.	0	1	2	3	4
16. Examines a variety of issues and their solutions.	0	1	2	3	4
17. Identifies the ecological costs and benefits of designated solutions to environmental problems and issues.	0	1	2	3	4
18. Identifies the human costs and benefits of designated environmental problems and issues.	0	1	2	3	4

Investigation Evaluation Total: Add all circled numbers.
Investigation Evaluation Average: Divide Investigation Evaluation Total by 6... _______________

Goal Level 4. Environmental Action

19. Communicates the need for responsible citizen action to resolve environmental issues. 0 1 2 3 4

20. Communicates that there are various levels of environmental action (individuals, groups, organizations, etc.). 0 1 2 3 4

21. Identifies examples of environmental action categories (persuasion, consumerism, political action, legal action, ecomanagement). 0 1 2 3 4

22. Examines scenarios/case studies that would allow the student to apply knowledge of environmental action and to choose responsible environmental action. 0 1 2 3 4

23. Identifies the human and ecological costs and benefits of identified environmental actions. 0 1 2 3 4

24. Takes individual and/or group action on an environmental problem they have identified and analyzed. 0 1 2 3 4

Environmental Action Total: Add all circled numbers.
Environmental Action Average: Divide Environmental Action Total by 6..... ________________

Goal Level 5. Teaching Methods and Practices

25. Do the materials provide specific training in the use of problem-solving skills such as observing, inferring, predicting, classifying, hypothesizing? 0 1 2 3 4

26. Do the materials provide opportunities to apply problem-solving solving skills with simulated models, real-life situations, scenarios, etc.? 0 1 2 3 4

27. Are the materials educationally appropriate for the intended student users (reading level, conceptual and skill levels, etc.)? 0 1 2 3 4

28. Would the materials be attractive and appealing enough to gain students' interests? 0 1 2 3 4

29. Do the materials contain goals and measurable objectives? 0 1 2 3 4

30. Do the materials provide sufficient suggestions or mechanisms for evaluation? 0 1 2 3 4

31. Is the information provided for students and teachers accurate? 0 1 2 3 4

32. Do the materials provide sufficient background information for the teacher? 0 1 2 3 4

33. Do the materials provide clear directions and suggestions for teaching? 0 1 2 3 4

Teaching Methods and Practices Total: Add all circled numbers.
Teaching Methods and Practices Average:
Divide Teaching Methods and Practices Total by 9. .... ________________

Summary Graph

Directions: Enter the AVERAGE VALUE FOR EACH GOAL LEVEL where indicated. Shade in the graph to correspond with the average value for each goal.

Ecological Foundations Average = _____

0	1	2	3	4

Issues and Values Average = _____

0	1	2	3	4

Investigation and Evaluation Average = _____

0	1	2	3	4

Environmental Action Average = _____

0	1	2	3	4

Teaching Methods and Practices Average = _____

0	1	2	3	4

SUMMARY DATA

Evaluator's Name:	Date:
Title of Curriculum:	Copyright Date:
Author(s):	Publisher:

Source: J.R. Gardella, *Environmental Education Curriculum Inventory* (Highland Heights, KY: School of Education, Northern Kentucky University, 1993).

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Comparing Four Environmental Problem Solving Models: Additional Comments

John Ramsey

In this reading, Dr. Ramsey discusses the four major environmental problem solving (EPS) approaches in use today. He looks at these in terms of their applicability to modern or postmodern perspectives as well as their relation to constructivist theory. He also compares them in terms of whether they exist as curricular models or simple instructional techniques. He then discusses the utility of each with respect its ability to function effectively in today's educational climates as well as its influence on the development of responsible citizenship.

Dr. Ramsey poses a number of truly critical questions and attempts to answer each succinctly and without mincing words. We suspect that this reading will stimulate a great deal of discussion in the educational community.

There is considerable interest in environmental problem solving (EPS), as reflected by an extensive literature. Its central role in the discussion and conceptualization of environmental literacy further adds to its significance. Bardwell et al. (1994) have, perhaps, the most comprehensive treatment of the topic to date, presenting the theories and various curriculum models as well as their analyses and implications. However, there are several important dimensions of the EPS discussion beyond those addressed by the Bardwell treatment. This paper revisits the topic of environmental problem solving models, asking new questions and presenting additional comment. In general, this paper will revisit four EPS approaches in terms of modern and postmodern perspectives and specifically will deal with the issue of application of postmodern educational approaches to modern contexts.

Review of Environmental Problem Solving Approaches

A review of the theory associated with the environmental problem solving construct and the discussion of its significance and role will not be presented here. Bardwell et al. have comprehensively traversed that landscape, and its inclusion would be redundant. However, in terms of EPS curricula, the focus of this paper, a review is critical. Figure 1 presents four EPS approaches, Hungerford, Hammond, Stapp, and Robottom, as described by Bardwell et al. (1994). For the sake of authenticity, the summary descriptions presented In Figure 1 are literal quotes from that source.

> **. . . all the models view education as change, in contrast to a perpetuation of the status quo. . . . All the models share a common goal, empowered citizenship, and they employ methods that are more powerful and more extensive than information-only delivery systems. . . . All the models attempt to achieve empowerment via an investigative problem solving process, typically beginning in middle school. Authenticity in terms of local community context is also a common dimension. All the approaches are, to varying extents, interdisciplinary. Considered as a whole, these approaches are meritorious and noteworthy, . . . their developers have taken to the [developmental] task with intelligence and zeal.**

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Figure 1. Summaries of the Robottom, Hammond, Stapp, and Hungerford Environmental Issue Problem Solving Approaches

	Robottom	Hammond
What Happens in the Classroom	Students and teachers jointly explore and work on a local controversial issue. Students undertake original research and generate new working knowledge about the issue. Students critically examine and appraise the relationship of community and environment and contribute their assessment as part of the wider community debate about the issue. Teachers are intimately involved in assessment and changing their approaches and roles and participate in researching their contribution to the inquiry.	Once a week this group of students meet to build rapport; learn about environmental resources and issues; practice skills in interviewing, lobbying, resolving conflicts, and communicating effectively; and collect data. The class members design a plan to contribute to or resolve an issue of their choice that involves elected leaders and community action.
Assumptions About Problem Solving	This is a community-based critical environmental inquiry. The problem is idiosyncratic and one cannot predict how to address the problem before the process. Problem solving is a practical activity - we learn through a process of praxis, reflecting critically on the meaning of our own interventions. The process and the needed skills emerge as participants adopt a perspective on their own role as problem-solvers. Constant evaluation and reflection allow for these skills to be developed.	Students are leaders and their leadership qualities can be improved by offering training, skill building, support, and success. Students must be encouraged to face disappointments with renewed energy, to come back again and again with a different strategy. Success occurs with effort. Environmental issues often involve a political power base, hence the involvement with elected officials.
Learning	The process of investigation is an action in and of itself. Action is not desired end; social change, or change in the relationship between community and environment, is. Considering the relationship of community to environment is an interdisciplinary process where several perspectives are used to analyze the situation.	Skills are developed or practiced during the process of group problem solving. These skills may be separately developed through direct instruction and constantly reinforced through mentorship and coaching from the teacher. Cooperative, group development is a key component of the educational goals.
Teaching Strategies	The teacher collaborates with students on the process and situation. The teacher may use the opportunity to research his or her own practice and how to organize educational experiences enabling problem solving.	The teacher is the coach or mentor. He or she uses direct instruction for significant skills such as lobbying or interviewing, and facilitates the problem solving process and perhaps, the choice of issue. The teacher asks students to envision a solution, and brainstorm alternative actions and realistic expectations.
Student Role and Involvement	Students undertake original research, learn by experience, and collaborate with students and community. There are numerous successful instances at both elementary and secondary schools. Whole class groups are involved at one time.	Secondary students carry a significant degree of responsibility for creating positive change, by building a group relationship of mutual responsibility, learning about community resources, choosing their own issue for class investigation, and organizing into action teams. Students plan what will be done each class session. Elementary students may participate by working with secondary students.
Evaluation Strategies	An ongoing process of constant reflective evaluation maintains a high quality of original research and skill development that emerges from unstructured investigation. The experiences are evaluated in response to emerging curriculum, not preordained objectives.	The project outcome is one element of the evaluation, and the project will continue until there is a positive outcome. Each student is required to invest a certain number of hours. The class sets criteria for grading, and grades are given through mutual consensus of the instructor and the student. Journals are used for reflection and evaluation.

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	Stapp	Hungerford
What Happens in the Classroom	Students begin by touring the school and neighborhood to select a problem they wish to impact. They research the topic, set problem objectives, and analyze the problem (who is affected, what created the problem, what is your power, how can it be used?) in small, cooperative groups. They use brainstorming techniques to determine alternative actions and define criteria for the project. They design an action plan and take action. Reflection on the success of their action leads them to revise original plans and repeat the process of plan-observe-act-reflect.	Teachers use a published manual to lead discussions or assign activities to practice skills of secondary research (using the card catalog) and primary research (interviewing, collecting survey data). Eventually students explore an issue individually, in small groups, or as a class, analyzing the various positions and perspectives. Students evaluate alternatives and explore five possible types of action. This process can evolve to real-world action taking, but it need not.
Assumptions About Problem Solving	Environmental issues have societal and environmental impacts and must be understood from both perspectives. A "full" investigation cannot occur before students begin to take action - the process of action and reflection yields additional information that enlarges the understanding of the problem. Students have the capacity to understand and take action; building their confidence and competencies is part of good education.	Problem solving skills depend primarily on understanding the issue. Issue investigation skills are sequential, linear, logical, and transferable from one problem to another. Values positions can be explored and students' positions determined from the evidence. New information developed by the student is limited by the research questions and available background information.
Learning	Skill building can occur prior to or during the process of problem solving. Teachers should assess student needs to determine if time must be set aside to deliberately build skills. Some skills will be acquired only during the process of problem solving. Emphasis is on group processing, communication, and leadership skills. Many forms of action are possible, including investigating an issue. The repetition of the plan-observe-act-reflect spiral allows students to discover other perspectives of the problem. This is an opportunity to "stay off solutions" and return to earlier phases of problem solving activity.	This model advocates learning skills in investigation and action taking. Modules provide instruction on action possibilities. Groups and individuals develop action plans and are encouraged, but not required, to carry these out. Problem solving process requires students to develop higher order critical thinking skills.
Teaching Strategies	The teacher is the facilitator of the process (not a commentator or director), a source of information, a coordinator of group activities and field trips. The teacher keeps a journal and log of activities. Team teaching is encouraged to provide additional and interdisciplinary perspectives and divergent views.	Structured skill development program is available though curriculum modules developed by Hungerford and others. Teachers primarily use direct instruction for skill development, though cooperative learning is encouraged. Small group and individual projects are often part of the investigation.
Student Role and Involvement	Students develop confidence in their own abilities to speak, contribute to a group, and analyze information. Students grow with the realization that their interests are more important than the textbook or the teacher's. An entire class may be involved, with small groups working on different aspects of the problem, from several weeks to a semester.	Specific skills are introduced to, practiced by, and applied by middle school students. Unless the "case study" approach is used, students become familiar with a wide range of issues during the skill development phase and focus on a local issue of their choice during the application phase.
Evaluation Strategies	Student reflection and self-assessment of growth are used, as well as an evaluation of the success of the action, teacher and student journals and logs, and the reflections generated through personal and group evaluation.	Students must reach competency in skills before doing an original investigation. Exercises to develop skills are provided. Teacher developed skill tests can be used. Students sign a contract with the teacher on an investigation plan and the teacher evaluates progress on the contract. Sample contracts are provided in the modules. Students prepare final oral and written reports on their issues for class presentation and teacher evaluation.

Source: Bardwell et al., 1994

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Figure 2. Comparison of Problem Solving Models

Hungerford	Hammond/Stapp	Robottom
More structure	<--->	Less structure
Investigation before action	<--->	Action informs investigation
Teacher as leader	<--->	Teacher as co-learner

Source: Tudor, 1994

There are several critical strands apparent in the summaries presented above shared among all four EPS models. In terms of sociological perspectives, all the models view education as change, in contrast to a perpetuation of the status quo. Certainly, this characteristic should be applauded. All the models share a common goal, empowered citizenship, and they employ methods that are more powerful and more extensive than information-only delivery systems. Again, much credit is due here. All the models attempt to achieve empowerment via an investigative problem solving process, typically beginning in middle school. Authenticity in terms of local community context is also a common dimension. All the approaches are, to varying extents, interdisciplinary. Considered as a whole, these approaches are meritorious and noteworthy, displaying many insightful educational characteristics. Collectively, the EPS approaches attempt to fill a critical educational vacuum, and their developers have taken to the task with intelligence and zeal.

Tudor (1994) also identified differences, depicted in Figure 2, among the four EPS approaches. These differences are noteworthy, justifying an expanded discussion. The differences serve as a baseline for the remainder of this article.

Now that the EPS stage has been set, let's begin with two claims. The first claim is that each EPS approach, without question, has the potential to "work," to be effective in particular, selective educational contexts. The central question, one more significant and not addressed by the literature, is which model is the best-fit, offering the most sustainable educational potential given the diversity of states, school districts, teachers, students, and classrooms. That is, to what extent do the EPS programs offer broad-based curricular-instructional utility? To use a metaphor, which EPS models are department stores and which are boutiques?

A second claim, more directional and pointed, is straightforward: The Hungerford approach is more appropriate and sustainable than other models for broad-based implementation in the heterogeneous American K-12 educational landscape. The rationales for this claim have philosophical, political, pedagogical, and institutional dimensions and factors. Synthesizing these factors into a coherent argument is not easy, and it is acknowledged that this effort will frame the rationale with only limited discussion of each. Each argument justifies an independent examination.

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Many educational issues in this day and age can be framed and interpreted in terms of the tension between modern and postmodern world views. I believe this is one such case. Bell (1996), an eminent sociologist, asserts that the American culture is postmodern, but its politic and techno-economy are still modern and that these differing views explain some of the tension within our society. This implies that our educational system was derived from and operates within a modern perspective. The significance of this cannot be underestimated in terms of assessing the utility of any curricular model, regardless of its intellectual merit or its trendiness and appeal. In terms of EPS models, the Hungerford and Stapp models have modern perspectives, compared with the postmodern orientation of Hammond and Robottom. These interpretations will be explicated below. First, let us digress, visiting both the modern and postmodern landscapes and providing a context for the discussion that follows.

Contrasting Modernism and Postmodernism

Modernism is characterized by emphases on the individual, progress, universals, regularity, and reason. It has been the dominate Western world view of the last 150 years, influenced by the tandem development of capitalism and science.

Smith's (1989) analysis of modernism includes three basic premises: (1) that reality is ordered; (2) that man's reason is capable of discerning the order of the universe; and (3) that the path to human fulfillment consists primarily of discovering patterns and laws. Thus, reality could be described, characterized, and explained in terms of factors, relationships, models, theories, and laws, and subsequently they could be used progressively.

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These products of reason listed above, so-called metanarratives or universals by postmodernists, could then be translated into sociological products, shaping individuals through education, coercion, or proselytism so that groups or society could be shaped into a predicted, desired image. Why? There is cosmic order; therefore, there is a potential human order that can be promoted. Ordered outcomes are a function of selected inputs within a programmatic structure. Social institutions, then, exist in a modern sense to promote outcomes, and, as such, they parallel the factory/system model producing goods and services used in economic sectors . . . linearity - singular explanations - solutions. The rational plan transcends its human constituents. Reality - reduced and simplified. The passwords - efficiency and effectiveness.

The public and private school systems, it would appear, are appropriate reflections of modernism. They are legalized and regulated by state-school district relationships; they are formatted, organized, and administrated around the factory model; they are focused at given outcomes; they are accountable to the stakeholders for efficiency and effectiveness; and their curricula and to some extent instructional activity are prescribed and regulated by the system. And most significantly for the purpose of this paper, there is no indication that any of this will change appreciably in US schools, with the exception of more accountability.

Now for a look at postmodernism, an intellectual movement originating with French philosophers after World War II. Sociologist Daniel Bell (1996) claims that our culture (but not our techno-economy or our political structure) is demonstrably postmodern. The cultural transition to postmodernism was stimulated by the arts and driven by a rejection of middle class values and the over-application of the reductionistic and materialistic scientific approach to complex conditions. Bell further asserts that the disjunction among modern and postmodern realms of our society is the source and explanation for selected cultural tensions and discrepancies.

Postmodernism rejects and de-structures traditional Western metanarratives and messages, placing emphases on self-concept, moral and ethical discourse, art and culture, and globalization (Anderson, 1995). Thus, truth is made, not found, and the explanation includes language, human diversity, and irregularity. The postmodern focus is self-realization, a personal and inductive process devoid of givens and presumed prescriptions. Personal freedom and expression is more important than rationality. In terms of education, postmodernists might characterize the history of education as the competitive but misguided tension among theory-based metanarratives, e.g., behaviorism, social development, cognitive development, etc., for a niche in the minds, hearts, and practices of educators.

The program template approach is "out." Structure is "out." Rather, focus is on social networks of collaborating individuals who negotiate mutual transactions and meaning through discourse. Language and social linkages, then, are the key. Personalized collaborations are "in." And with this softer, more seamless structure comes shared power, negotiated control, multiple approaches and solutions, multifaceted and sometimes divergent outcomes, and both evolutionary and pragmatic growth and change. Thus, postmodernists are appalled by the imposition of theory through a programmatic structure designed to produce given outcomes. For them, that format is dehumanized, too mechanical, too prescriptive, too presumptive, and too imbalanced in terms of power relationships. For example, postmodern dieters would prefer the Weight Watchers approach, emphasizing the personal choice of multi-faceted methods and networked support groups to the monolithic theory and protocol of Atkin's protein metabolism approach.

Let us examine the power dimension more closely. Foucault (1979, 1995) pointed out that the metanarrative and its derived structured program implied unilateral control and that most modernistic social interactions contain an often ignored power dimension. Thus, the force binding the metanarrative->structure->outcome is power, operationalized through policy and protocol. Individual human constituents are a victim of a more powerful, institutional society that superimposes the metanarrative via programmatic structure. For example, consider the educational theory-educational practice binary relationship. Postmodernists would explain that this binary exists because of the institutional power exercised by and implicit to theorists' institutional structure. What does power have to do with this paper? The postmodern EPS approaches oppose the traditional teacher-student binary, preferring one with mutual/shared power relationships. Refer to Apple (1983; 1993) for a treatment of dominant race exercising power over minorities through curricula and testing.

As an intellectual and social movement, the postmodern traditional has undergone a remarkable growth trajectory, building an extensive literature of thought and practice in many disciplines and other societal realms. For example, several Houston-area energy corporations have hired postmodern consultants to help reframe the corporate social and organizational configurations and protocols, destructuring social, physical, and relational barriers.

One additional dimension needs to be presented, the idea of constructivism. This postmodern learning referent will be contextualized within a discussion of changes in science. One of the greatest influences on the modern tradition was science. Science and its tenets provided a solid basis for knowledge, enabling its empiricist users to predict reality with theory. What a powerful, explanatory force it was and is, a complete discussion of which is beyond the scope of this paper and author.

Science's predictions based on empirically-grounded theories presumed singular solutions, answers not only to the natural world but also to societal questions and problems. And so this materialistic paradigm became a guiding metanarrative in our culture. It was, in fact, a compatible ally of capitalism in industrialized societies. Organizations, institutions, and individuals also embraced the science paradigm as a societal change vehicle.

Modernists believed that science and technology could solve, for example, hunger, overpopulation, criminal behavior, child abuse, and environmental degradation. (Postmodernists believe these effects were, in fact, caused by modernist activities).

The scientific enterprise has provided changes in the human knowledge base. Consider, for example, the recent discoveries of the Hubble telescope and the Mars Explorer. Consider also our enhanced knowledge of human genetics and its associated, powerful implications for our lives. In fact, there are many who believe that the scientific and technological capabilities exist to remediate or prevent environmental degradation, an example of pro-environmental modernists' beliefs that the modern paradigm is appropriate but in need of factoring an environmental impact statement into the equation of capital, labor, resources, products, costs, and profits.

However, our scientific paradigm is changing (Davies & Gribbon, 1994). Scientific insights such as chaos principles, the uncertainty principle, and the neurological relationship of perception and cognition have mitigated the notion of material reality. It is also now evident that the observer influences the observation. Thus, observations are selective, matched to preconceived theories, and predictions of unpredictability are also valid. Finally, cognitive science itself has called into question the validity of the external observation, joining a cohort of philosophers critical of aspects of modernism (Smith, 1996).

In terms of education, humans are no longer perceived as Skinnerian machines. So, behavior

Science and its tenets provided a solid basis for knowledge, enabling its empiricist users to predict reality with theory. What a powerful, explanatory force it was and is . . .

ism is "out" and constructivism is " in." Based on recent developments in cognitive science and linguistics as well as misconception research, constructivists embrace the notion that there is an external world, but we can never know it individually or collectively (von Glaserfeld, 1991). This new insight, paralleling the paradigm shift in science itself, explains why the most recent derivative educational research has been classified as ventriloquism (positivistic associated with modernism) and voices (qualitative), or emancipation (critical theory), the latter two associated with postmodernism (Zimmerman, 1994). The emphasis is no longer on quantifying observations in a Solomon-four square design, but it is on listening to and interpreting the voices that communicate beliefs, ideas, emotions, and images associated with perceptual bases of cognitive function.

It would be inappropriate to leave this discussion without briefly discussing validity which I believe is also important to later aspects of this paper. As the science paradigm shifts and evolves, we must be cautious to decide and to act responsibly. Science and its empirical values and processes cannot be cast aside in societies where modernism is established and functioning. Ours, for example! Sagan (1995) reminds us that science offers the best validity process available among belief systems. And despite the use of science in modern societal institutions, many individuals are still susceptible to the invalid and irrational. In his view, the demon-haunted world still lurks beneath a polished societal veneer. Consider, for example, the New Age belief that the earth has eleven energy centers, e.g., Queensland, New Zealand, where energy force fields converge. Also consider the best-selling book, The Celestine Prophecy (Redfield, 1996). It offers predictions for the coming millennium, an event in our Christian-based calendar. Its baseline, however, is tied to an ancient South American calendar, a completely different timeline.

Perhaps the misinterpretation of the role of science as well as its misuse are possible problem sources. The role of science is not to define and attribute meaning to our lives; we are responsible for that. Its use has also included the misapplication of reductionistic research models to complex social phenomena. The result of this was often prediction based on decontextualized quantification. Matching research questions with appropriate research models is, however, a viable mechanism for knowledge and understanding. The postmodern context offers a wider array of potential research questions and research models as well as enhanced roles for contributions from evaluation and action research. Postmodern researchers have not abandoned the foundation of empirical validity (Carspecken, 1997), but science is undergoing a paradigm shift, evolving its premises, beliefs, and practices as it has in the past (Kuhn, 1970). The current science view offers a larger window of inquiry, both in terms of questions and methods.

> **. . . science offers the best validity process available among belief systems. And despite the use of science in modern societal institutions, many individuals are still susceptible to the invalid and irrational. In [Carl Sagan's] view, the demon-haunted world still lurks beneath a polished societal veneer.**

Comparing the EPS Approaches

The following section is framed in terms of a series of questions that synthesize data from the earlier EPS section and modernism/postmodernism section. Let's begin with the theory->program-> outcomes template as a basis of analysis. Both Hungerford and Stapp use theory as the basis of their respective models. Hungerford's approach is based on the variables associated with environmental behavior (See Winther et al., 1996; Marcinkowski, this volume). Stapp uses the community action research model (Stapp & Wals, 1994). Thus, both approaches can be characterized as a modern orientation. On the other hand, both Hammond and Robottom defy curricular and instructional structure and can be characterized as postmodern.

1. Do destructured EPS approaches provide broad-based education?

Only the American culture is postmodern; our politic, our techno-economy, and most certainly our K-12 educational infrastructure is not (Bell, 1996). Thus, the Robottom and Hammond approaches are postmodern square pegs in modern round holes, regardless of the desirability (or philosophical significance) of decentralized, atheoretical, bottom-up decision making associated with the postmodern view as opposed to top-down, theory/policy/protocol educational decision making associated with the modern view.

From a careful consideration of the Hammond model, one can infer that its utility rests largely with Hammond as a teacher and individual in his unique context. Hammond's pull-out program with selected students, in fact, implies that Hammond has negotiated an episodic instructional organization within his school district. Probably, this format is not generalizable to many other educational settings. Eclectic instruction and the lack of printed curricula imply that EPS instruction is attributable to Hammond's teaching knowledge, skill, and disposition. In short, Hammond's EPS model appears to be, to a large extent, a function of Hammond the teacher. It works effectively and probably brilliantly for Hammond in his context; the extent to which it is exportable to other teachers and settings may well be questionable.

Both Tudor (1994) and Robottom (1994) imply that prepared curricula offering objectives and following an instructional storyline are behavioristic. Again, this viewpoint has postmodern overtones, invalidly equating system theory with Skinnerian learning theory. Although many schools have Skinnerian artifacts, all school have system organization and structure that demands the articulation of parts into a whole. Objectives and storyline are components of this systemic effort. Further, the presence of objectives suggests identified outcomes. The American public school system was, in fact, established to foster outcomes, e.g., communication, symbolic literacy of several dimensions, critical thinking, and citizenship. Self-realization is not nor has it ever been a part of this package. Ignoring the outcomes-based dimensions denies the reality of mainstream American educational infrastructure and protocol.

The current trend toward standards-based education in America in mathematics, science, and environmental education is an effort to synthesize programmatic outcomes, curricula, and instruction into a more cohesive package, a typically modern approach. A denial of the existence and significance of the modernistic dimension of America is not only marching out-of-step but also marching in a different direction.

Another point worthy of consideration is national standards. The current trend toward standards-based education in America in mathematics, science, and environmental education is an effort to synthesize programmatic outcomes, curricula, and instruction into a more cohesive package, a typically modern approach. A denial of the existence and significance of the modernistic dimension of America is not only marching out-of-step but also marching in a different direction. The lack of adaptation by approaches such as the Robottom EPS model renders it a boutique, not a department store, in the effort to implement broad-based environmental education in American classrooms.

Perhaps, the most disconcerting features of Robottom's argument is the author's confusion about the differences between curriculum and instruction and the differences between the Skinnerian-based pedagogy and an outcomes-based organizational format. This confusion poses a significant trap, snaring those who are not experienced classroom educators. Hungerford offers an EPS curriculum. The other three models are essentially instructional. This won't fly within the existing educational infrastructure.

Curriculum refers to an instructional plan and associated instructional materials. Curriculum is prepared for discrete but different audiences, e.g., students, other teachers, school boards, parents, state agencies. Curriculum, in this dimension, is the forum acting as a catalyst for the synthesis of ideas by players in the educational scene to communicate, plan, and decide. It is, ultimately, a reflection of the tacit but negotiated consensus about educational goals and outcomes, taking into account the needs of society, learners, and the discipline. The lack of curricular format diminishes the discussion and the democratic basis of public education in terms of states, in loco parentis, and experts.

Instruction refers to the actual classroom instructional transactions - what happens in the classroom. Robottom implies that curriculum with stated objectives has only a student audience who is treated as a manipulated machine. This misguided position denies the modernistic reality of school as well as the constructivistic potentiality of instruction. Now for the trap. Robottom believes that destructuring goals, objectives, and instruction frees both students and teachers of imposed metanarratives. This rarely occurs; instruction-only approaches tend to make all the classroom transactions more teacher-dependent. Yes, Robottom may offer a completely student-centered approach, but the quality and quantity of the educational experience is a function of the facilitation skills and dispositions of the teacher.

Most classroom teachers are not trained facilitators. In fact, Haberman (1995) informs us that most classroom teachers make instructional decisions on the basis of management, without taking into account student-related factors. Consider, for example, that the average teacher in the forty-four school districts of the Houston metroplex has lessthan a four year teaching career. Unfortunately,

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> **. . . constructivism is not a learning theory but a referent (a postmodern notion) and that any type or format of instruction can be made more constructivistic. Their characteristics include authentic experience, social interaction, sense making, and connections to prior knowledge. Thus, all of the [EPS] models can claim to be contructivistic.**

the focus in such a situation tends to be on maintaining staff, with little effort directed at sophisticated programs and instruction. Given this, there is little environmental education empowerment for students across a wide spectrum of classrooms and settings in this situation.

Only the Hungerford model was written and researched by mainstream classroom educators and teachers who took into account the educational infrastructure and its mechanisms that, for good or bad, set agenda through legislation, policy, and guidelines. Here's another example of why this is important. Few states have policy about environmental education; therefore, the presence of environmental education (and EPS) rests on its ability to claim and attain other general education goals as well as its own. Many states and districts have in place problem solving as an identified outcome. This includes an array of research skills. The Hungerford EPS model is successfully and effectively implemented in the two largest Houston-area suburban school districts because it identified and met other recognized, more generalizable outcomes in an EE context. In short, the Hungerford model delivers the goods at several levels and is used because it is multi-faceted.

2. Is pro-environmental indoctrination a problem with the EPS models?

Three of the EPS models begin with action, based on the tacit assumption of a pro-environmental viewpoint on the part of the student. As most environmental educators are well aware, education is beset by cries of bias, emotion, and indoctrination (for example, refer to Ramsey in this volume). Tudor (1994) makes the point that the Hungerford model spends more time in the "problem space" than do the other models. I would add that it is this model's emphasis on information and understanding as the basis for decision making and action which characterizes it as unbiased, open, and democratic.

Because the other models are, in fact, instructional and not curricular, they will also be susceptible to the claim of indoctrination. Any EPS model that begins with action cannot claim an informed decision making outcome. This position is supported by the recently adopted curriculum guidelines in environmental education by the NAAEE (NAAEE, 1996). The implications of this dimension cannot be underestimated.

3. Can a skills-approach EPS curriculum embrace constructivistic instruction?

In short, the answer to this question is yes. Tobin and Tippins (1993) have characterized constructivistic instruction. They assert that constructivism is not a learning theory but a referent (a postmodern notion) and that any type or format of instruction can be made more constructivistic. Their characteristics include authentic experience, social interaction, sense making, and connections to prior knowledge. Thus, all of the models can claim to be contructivistic.

Only the Hungerford model takes a direct skills approach. Hammond and Stapp might or might not use skill-focused instruction. Robottom, in fact, criticizes skills instruction. Let's be clear. Skill instruction is used to facilitate action-oriented outcomes, as differentiated from conceptual outcomes. If you survived your last scuba dive, your last plane trip, or your last medical operation - thank the skills approach. It is the most common and the most appropriate educational approach for effective and efficient results-oriented outcomes. Can you imagine the application of the Robottom model to drivers education or to medical education? Fostering empowered citizenship outcomes demands inputs and applications.

Robottom claims that each environmental issue and its solutions are unique, defying characterization typical of a skills approach. This is rubbish! Research with the Hungerford EPS has clearly demonstrated its effectiveness in fostering the skills needed by learners to comprehend and investigate a huge array of environmental issues. The skills approach can be applied in an array of contexts with an array of issues.

The format of the Hungerford EPS model suggests linearity. This is not the case. The model will fail if instruction is undertaken in a direct, read, discuss, follow-the-book method. Hungerford model teachers pick and choose from an array of activities, selecting the sequence and pattern that is a best-fit for their context. In general, however, concept and skills instruction is teacher-mediated and leads to an independent EPS application by students.

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4. Should research be discarded by environmental educators?

Only the Hungerford model has an empirical track record, juried by peers, published in the literature, and replicated via many iterations. In short, there is a treatment effect as a function of Hungerford's environmental problem solving. A simple question - where is the body of empirical evidence for the other environmental problem solving approaches? Even postmodern-oriented researchers respect and demand validity, e.g., (Carspecken, 1996). Surely, evidence and not the physic hotline must be used for decision making in environmental education.

Discussion

What we seem to have here are four EPS models that attempt to improve the environment through education. Again, it should be noted that all four of the models share a common goal, empowered citizenship, and they employ methods that are more powerful and more extensive than information-only delivery systems. Much credit is due the developers. All the models attempt to achieve empowerment via an investigative problem solving process. Authenticity in terms of local community context is also a common dimension. All the approaches are, to varying extents, interdisciplinary. Considered as a whole, these approaches are meritorious and noteworthy, displaying many insightful educational characteristics. Collectively, the EPS approaches attempt to fill a critical educational vacuum.

When viewed in the context of modern vs. postmodern thought, we begin to see startling differences arising between the models. When each is inspected in light of current educational thinking and practice, only one of the models seems to have the potential for use with large numbers of students in large numbers of schools. This unfortunate circumstance might be mitigated by changes in the protocols of the less-inclusive models. Regardless, all must bear the responsibility for empirically demonstrating the ability to move large numbers of learners in positive environmental directions over long periods of time, i.e., to demonstrate a powerful treatment effect.

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> **. . . all [of the EPS models] must bear the responsibility for empirically demonstrating the ability to move large numbers of learners in positive environmental directions over long periods of time, i.e., to demonstrate a powerful treatment effect.**

I focus more [now] on letting the students direct their own learning. . . . less worried so much about getting all the facts because they learn from the facts when they do their own investigations. Show them that science is not a right or wrong answer and that you have to look at all options - and sometimes it's just picking one that's better than the other. . . . and then also letting them realize that one person doing something does make a difference. It makes them feel like that they are important, that they can change things. And I think that it affects them in long term. . . . I still think just making them have to do some thinking and [me] not standing up there and spouting off a bunch of facts and figures - and making them feel that science is . . . it's a lot more of, 'Well, I don't know, you tell me. What do you think? How do you feel about that? What do you think should be done?' And I think that, really, I got away from that and it's been a big focus, even with other teachers I work with, a big focus on making them [the learners] find things out and not just saying "this is the right way or the wrong way."

I'm probably doing a lot more focusing on letting [students] lead certain sections of the learning or doing group learning or cooperative learning or whatever. I think I do a lot more of that!

A Maryland Middle School Teacher. From an interview conducted with her by Versil Withrow, Workshop Coordinator for The Center for Instruction, Staff Development and Evaluation, 1997.

> **An environmental issue is a socially or ecologically significant problem, somehow related to the environment, about which there are differing human beliefs and values.**

"Issue Analysis": The Method

Complex environmental issues are often confusing for students. The issue analysis technique allows learners to organize information about an issue in a sound conceptual framework. The method is designed to develop a set of skills that can be broadly applied and can be used in conceptualizing both current and future issues.

Training in the technique involves a three-stage sequence using a "define-practice-apply approach." In the first stage, an overview of the technique is presented to the learners by the teacher. The specific components of issue analysis (Table 2) are introduced and defined. A "value descriptor" list (Table 3) is presented as a reference to aid in the identification of value positions. This list provides definitions of common value perspectives, e.g., political, social, scientific, economic, and so on.

Table 2 - Components of Issue Analysis

Problem: A condition in which the status of someone or something is at risk

Issue: A problem or its solution about which differing beliefs and values exist

Players: The individuals or organizations having a role in the issue

Positions: The postures of the players concerning the issue

Beliefs: Those ideas concerning the issue, whether true or false, held by the players

Values: Those guides that tend to reflect the relative importance of beliefs in a given situation

Solutions: The various strategies available to resolve the issue

Table 3 - Examples of Value Descriptors

Aesthetic: Referring to an appreciation of beauty through the senses

Cultural: Referring to the maintenance of the attitudes and practices of a societal unit

Ecological: Referring to the maintenance of the integrity of natural systems

Economic: Referring to the exchange of goods and services for money

Educational: Referring to benefits derived from learning/instruction

Egocentric: Referring to a focus on self-satisfaction and personal fulfillment; a "me" oriented value

Legal: Referring to the law and its enforcement

Recreational: Referring to the use of leisure time

Social: Referring to shared human empathy, feelings, and status; an interaction of the human condition

Note: For a more complete listing of value descriptors, see Hungerford et al. 1988.

In the second stage, a "practice" issue, selected by the teacher, is presented to the students. Magazine or newspaper articles, video programs, or guest speakers are typically used at this stage. Working in small groups, the students identify and communicate the issue, name the key players and their positions on the issue, summarize the belief statements of those players, and identify the values that appear to be driving those beliefs. Finally, each small group writes and presents an "issue analysis report" to the class. This issue analysis report summarizes the findings of that group regarding an identification of the issue itself, the players, the players' positions, the players' beliefs, and the players' values. During this small group process, the teacher acts as an evaluator of the analysis and a facilitator for the group.

> **. . . issues arise when there are controversies about . . . problems and their solutions.**

A Technique for Analyzing Environmental Issues

John M. Ramsey, Harold R. Hungerford, and Trudi L. Volk

Teaching students to deal effectively with issues is a critically important component of environmental education. However, complex environmental issues are often very confusing for students. The issue analysis technique presented here allows learners to organize information about an issue in a sound conceptual manner and without bias. In so doing, students will better understand what the authors sometimes refer to as "the anatomy of issues."

How can teachers help students learn how to analyze important environmental issues so as to understand thoroughly the complexities of an issue? What is the "anatomy" of the issue? Who are the "players"? What are their positions? What do the players believe about the issue? What values are represented in those positions and beliefs? Are the needs expressed by the players' real needs or only perceived/rationalized needs? What are the implications of the various solutions put forward by the players?

Few environmental educators would argue the importance of dealing with critical issues as a major component of instruction. In fact, "Goals for Curriculum Development in Environmental Education" (Hungerford, Peyton, and Wilke 1980) places issues at the heart of the environmental curriculum. If students are to eventually become skilled in issue investigation, evaluation, and resolution, they must thoroughly understand the anatomy of issues. It is, therefore, important for them to analyze selected issues in some depth. The authors have developed a promising technique referred to, simply, as the "issue analysis technique." This technique, presented here, has been developed for use in middle and secondary schools and has also shown promise for use in non-formal situations.

Modern life is filled with social issues having environmental dimensions. These issues originate when situations arise in which the status of something or someone is at risk as a result of natural events or man's activities. These situations result in very specific problems.

Subsequently, issues arise when there are controversies about the problems and their solutions. An environmental issue is a socially or ecologically significant problem, somehow related to the environment, about which there are differing human beliefs and values. A few examples of environmental issues are listed in Table 1.

Table 1 - Examples of Issues
Should current federal and private proposals for protecting the nation's waterfowl population be improved?
Should oil and gas development be permitted in the Arctic National Wildlife Refuge?
Does aquaculture technology threaten the genetic diversity of wild fish populations?
Are toxicity standards for solid waste storage and disposal appropriate?
Should genetically engineered organisms be introduced into natural ecological systems?
Should the National Park Service continue its "let burn" policy when natural fires occur within park boundaries?
Are natural pest management techniques in agriculture as effective and efficient as petrochemical methods?
Is the incineration of municipal solid waste a risk to public health?

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In the third stage, an "application issue" is presented. Typically, this application issue is more complex than the practice issue. Again, students work in small groups, identifying components and presenting a synthesis of the issue analysis. Another approach might have students collecting their own issue articles from secondary sources for analysis. These articles could be analyzed either on an individual or small-group basis, depending on the preference of the teacher. Regardless of the strategy used, students should have the skills to independently analyze a broad array of environmental issues after sufficient practice.

An example of an article used in this process - "*Farmers, Hunters Spar Over Refuge*" - is reprinted in Figure 1. For an analysis of that article using the "issue analysis technique," see Table 4.

Other Considerations in Issue Analysis

Issue analysis provides the student with a mechanism to thoroughly understand an issue. Subsequently, a number of other analyses are possible. The following questions highlight some of the important questions that might be considered at this point.

- How valid is the information used by the players in defending their positions on the issue?
- What additional information must be obtained (by the students) in order to make an informed decision concerning this issue?
- Do the solutions posed by various players address the real environmental problem(s), or do they simply reflect other vested interests, e.g., economic, egocentric, political, etc.?
- What are the short- and long-term consequences (both benefits and losses) associated with the proposed solutions?
- Who pays the costs; who shares the benefits (of the solutions)?

Issue analysis provides the student with a mechanism to thoroughly understand an issue.

Figure 1 - Article for Issue Analysis

Farmers, Hunters Spar Over Refuge
Paul Hampton
The St. Louis Post-Dispatch
April, 16, 1989

ULLIN [Illinois]-Farmers and hunters are sparring over a proposal for a national wildlife refuge in the Cache River bottom. But officials planning the refuge said comments from both sides will be used to draft a proposal for the refuge.

Nearly 200 residents of the area jammed the Shawnee Community College cafeteria Thursday night to hear the latest news on a proposal to set aside the swamp that environmentalists claim contains 1,000-year-old cypress trees and as many as 36 endangered or threatened species of plant and animal life.

The U.S. Fish and Wildlife Service also considers the swamp a key link in its plan to increase migratory bird population on the lower Mississippi Valley portion of the Mississippi flyway, according to Andrew French, project manager of the service.

A tentative plan calls for the fish and wildlife service, the state Department of Conservation, Ducks Unlimited-a private hunters' group-and the Nature Conservancy-a private environmental group-to work together to acquire land.

French stressed that no boundaries for a refuge have been drawn, and no land has been purchased for the purpose of establishing the refuge.

"We'll use the questions raised here tonight to draft an environmental assessment," French said. "We want to have a collection of ideas and alternatives for using the area. Then, once we have a draft, probably in late June, we will meet again to discuss all those proposals."

Farmers were concerned that the federal government would force them to sell their land or that their land would be flooded even if it wasn't bought.

Both French and Paul Dye, of the Nature Conservancy, said the groups would buy only from willing sellers and there would be no condemnation proceedings to force the sale. French said federal law restricts anyone-even the federal government-from flooding lands it does not own.

French said that although the refuge also could provide opportunities for economic diversification through businesses and services that cater to refuge visitors, the development of the area around the refuge would be left up to the private sector.

One woman, who identified herself as a farm wife, said the government should place a higher priority on human habitat than wildlife habitat.

"We feed people," she said. "With so many starving people, how can we take farmland away to make room for ducks and fish?"

But the largest round of applause was reserved for 72-year-old Ray Gore, who said farmers had little reason to fear the refuge because they could make more money renting their land to hunters than they could by farming it.

"You people who haven't been down to the Cache don't know what this is all about," Gore said. "I've lived on the Cache all my life. A person who is starving is starving because they won't get off their can and earn a living."

"We have to go plumb out of the state of Illinois to find a decent place to hunt. You'd make more money off a duck blind or a goose pit than you would off the crop off that land."

French said that if the refuge plan is approved the amount of land the government would buy will depend on how much money it has available.

"It could take a few years; it could be several years," he said. "It also depends on how many willing sellers there are."

(Adapted and reprinted here with permission of *The St. Louis Post-Dispatch.*)

Table 4 - Issue Analysis: An Example

Players	**Positions**	**Beliefs**	**Associated Values**
Environmentalists	Refuge proponents	The area contains 1,000-year-old cypress trees and as many as 36 endangered or threatened species of plants and animals.	Ecological
"Farmers"	Refuge opponents	Fear that the federal government would force them to sell their land or flood it even if it wasn't bought.	Cultural Economic
Andrew French Paul Dye	Refuge proponents	[Environmental] groups would buy only from willing sellers-there would be no condemnation proceedings.	Cultural Legal
Andrew French	Refuge proponent	Federal law restricts anyone from flooding lands it does not own.	Legal
"Farmers"	Refuge opponents	Property taxes would increase to offset the loss of property tax on lands in the refuge.	Economic
Andrew French Paul Dye	Refuge proponents	Refuge Revenue Sharing program and continued tax payments by the Nature Conservancy would offset concerns about increased land taxation.	Legal Economic
Farm wife	Refuge opponent	The government should place a higher priority on human habitat than wildlife habitat -" . . . how can we take farmland away to make room for ducks and fish?"	Social
Ray Gore	Refuge proponent	Farmers had little reason to fear the refuge because they could make more money renting land to hunters than they could by farming it. "A person who is starving is starving because they won't get off their can and earn a living."	Economic Social
Andrew French	Refuge proponent	The amount of land the government would buy would depend on how much money it has available.	Economic

Table 5 - Instructional Goals for Issue Instruction

Goal 1: Foundations level
This goal level seeks to provide learners with the knowledge needed to understand and investigate environmental issues. This would include basic science and social studies content associated with the issues themselves.

Goal 2: Issue awareness level
This goal level seeks to foster the conceptual understanding of environmental issues themselves. This level also involves an understanding of the need for the resolution of environmental issues through investigation, evaluation, personal decision making and citizenship action.

Goal 3: Investigation and evaluation level
This level provides for the development of the knowledge and skills necessary to permit learners to investigate issues and evaluate alternative solutions for resolving these issues. It also involves some form of student involvement in the investigative process, including data collection, interpretation, and communication.

Goal 4: Citizenship responsibility level
This level seeks to guide the development and application of those skills necessary for learners to make responsible decisions and take positive action aimed at the resolution of environmental issues.

Source: Ramsey and Hungerford 1989 adapted from: Hungerford, Peyton, and Wilke 1980).

Curricular Goals for Environmental Education

Issue analysis promotes students' understanding of an issue. But a critical question has not been answered. How does it best "fit" in an environmental curriculum? Issue analysis probably is best viewed as one of several instructional "means" related to issue instruction rather than as an "end." The "Goals for Curriculum Development in Environmental Education" (Hungerford, Peyton and Wilke 1980) have been adapted for use in science-technology-society (STS) education (Ramsey and Hungerford 1989) to produce a set of four educational goal levels as curricular guides for STS issue instruction. Because environmental issues must be considered within the realm of STS issues, the goals work equally well for the environmental educator.

The goal areas include science foundations, issue awareness, issue investigation, and issue resolution (Figure 5). Collectively, the goals encompass not only the knowledge and skills needed by students to understand and investigate environmental issues but also the skills needed to participate in their solution. Thus, the goals focus on *citizenship responsibility*. Given this framework, the "issue analysis technique" is a method appropriate for accomplishing the issue awareness goal; i.e., the technique permits learners to become aware of and understand the complexities of a variety of environmental issues. Although this strategy can be used in isolation, ideally, instruction should follow that permits learners to develop the skills associated with issue investigation and evaluation and citizen action.

Final Thoughts

The authors have noted over the years that, in many instances, learners tend to read into a stated position more than the prose permits. Learners, therefore, should be cautioned to make their value decisions based on the stated position rather than on an inferred position. This is not to say that students should not have an opportunity to discuss "what is really going on" with respect to the players' position(s) and stated belief(s).

> **. . . the [issue analysis] technique permits learners to become aware of and understand the complexity of a variety of environmental issues.**

"[S]ome interested parties will, in reality, hold two positions; the one they espouse publicly and the one they act on. In other words, some will say one thing and do another simply to maintain a certain image in the public eye. [This] is probably more commonly found coming from either state and federal policy making/enforcing bodies, or from business/industry representatives than elsewhere" (Marcinkowski 1989).

In the article "Farmers, Hunters Spar Over Refuge," it is quite possible that the farm wife had two positions, the public position and the one she held privately. The authors suspect that the underlying value with respect to her position may have been egocentric rather than humanistic (or "social," as it was termed in the issue analysis). However, the possibility that she holds a public position and a different private position is not borne out by the prose and, therefore, only the prose was used for analysis. These kinds of situations present opportunities for rich discussions and significant skill development for learners.

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> **"I have gone to considerable effort to present [to you the student] opposing views on these complex and highly controversial life-and-death issues in a balanced way. My goal is not to tell you what to think but to provide you with ecological concepts and information which you can use to reach your own conclusions. The more I have studied environmental issues, the more I have realized how complex and interrelated they are."**
>
> **G. Tyler Miller, 1998**

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So . . You Want to Teach Issues?

John Ramsey and Harold Hungerford

The basis for this reading appeared originally in the Spring 1989 issue of *Contemporary Education*. Although its focus was on what were called "science-related social issues" or a synonym "STS issues" the article appears here because all environmental issues are also science-related social issues. There is simply no escaping that fact, because all environmental issues have both a science component and a social component. Therefore, this reading is as important for environmental educators as it was for science educators.

In this reading, Drs. Ramsey and Hungerford define science-related social issues, provide some options for the teacher who wants to help students learn about these issues, state what the outcomes of instruction should be, and communicate two different models which are available for providing instruction in science-related social issues.

Science-related social issues? What are they? What is their role in a sound general education for young citizens in a democratic society? Can we change student behavior in an appropriate direction by teaching issues? How should we go about teaching them? Where can we obtain information about appropriate teaching methods? And, what does research have to say about all of this? Such are the questions being asked by many, many teachers as the focus of science teaching shifts from what one observes in the traditional science classroom.

With these questions in mind, the writers hope to help teachers everywhere conceptualize the notion of the science-related social issue and provide some very real assistance in the teaching of issues. Over the years, the writers have had the distinct pleasure of helping many elementary and middle school teachers implement issues instruction in their classrooms. Many of the ideas presented here are those developed both prior to and during those years.

What *Are* Science-Related Social Issues?

Perhaps the simplest definition of science-related social issues goes as follows: "A science-related social issue is an issue which has its roots in science and/or technology and involves a problem surrounding which there are differing beliefs and values." Therefore, issues such as those involving abortion, genetic engineering, nuclear waste disposal, ground water contamination, human population, land use management, endangered species, tropical rain forest destruction, desertification, recycling, solid waste management, clear-cutting of temperate forests, and fisheries management would fit this definition, as would a host of others.

The writers have established two rules which govern the identification of a science-related social issue: (1) *It must truly be an issue*, i.e., people must, at some point, disagree concerning the status or resolution of the issue because of differing beliefs and values; and (2) *it must be of some social significance and be related, in some dimension, to either science or technology*, i.e., it meets the STS test (the science-technology-society interface must be evident). Given that a problem/issue meets these criteria, one can assume that a science-related social issue has been identified. Figure 1 represents the three basic *interactions* of science, technology, and society (STS interactions), i.e., science interacts with technology,

> ***Science education should produce informed citizens prepared to deal responsibly with science-related societal issues. . . . [Science] must instill in students a sense of responsibility, an appreciation of the potential of science to solve or alleviate societal problems and a sense of custodianship to protect and preserve that natural world with which science concerns itself.***
>
> **Stuart Kahl & Norris Harms, 1981**

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science interacts with society, technology interacts with society. For clarification, an example issue related to each type of interaction has been provided. Each of these particular examples pertain to rather diverse issues. With at least some issues, one can find aspects which would fit each of these interactions. And, too, with the examples shown arguments could be made for other classifications as well. Figure 1 is simply a mechanism for analyzing issues according to the interactions embedded in them and is very useful for this purpose.

What Are the Teacher's Options?

It appears as though a teacher has a number of options for dealing with science-related social issues. Among these are: (1) to ignore issues completely; (2) to read about issues in a textbook; (3) to develop issue case studies for presentation in the classroom; or (4) to train and permit students to investigate issues as a part of their learning experiences. Two of these options (1 and 2) appear to be rather inadequate, if issue instruction is as important as professionals believe it to be. Although textbook treatment of issues is definitely improving, many teachers find that the textbook treatment is inadequate in terms of depth, student interests, or the locale in which the teacher finds his or herself teaching. Therefore, options 3 and 4 appear to be most appropriate if an in-depth issue presentation is desired. These are also the options that will be dealt with here.

What Should the Outcomes of Instruction Be?

Just what should students be able to *do* as a function of instruction on issues? Speaking about STS education in the Project Synthesis (1981) report, E. Joseph Piel stated that one of the outcomes should be to "develop personal values towards an improved quality of his/her [the student's] environment and demonstrate behavior through life that indicates a desire to improve it." It is our professional opinion that this goal is a difficult one to meet in the science classroom. However, in a time of local, regional, national, and international crises, should we expect less of ourselves as teachers and of our students? We think not!

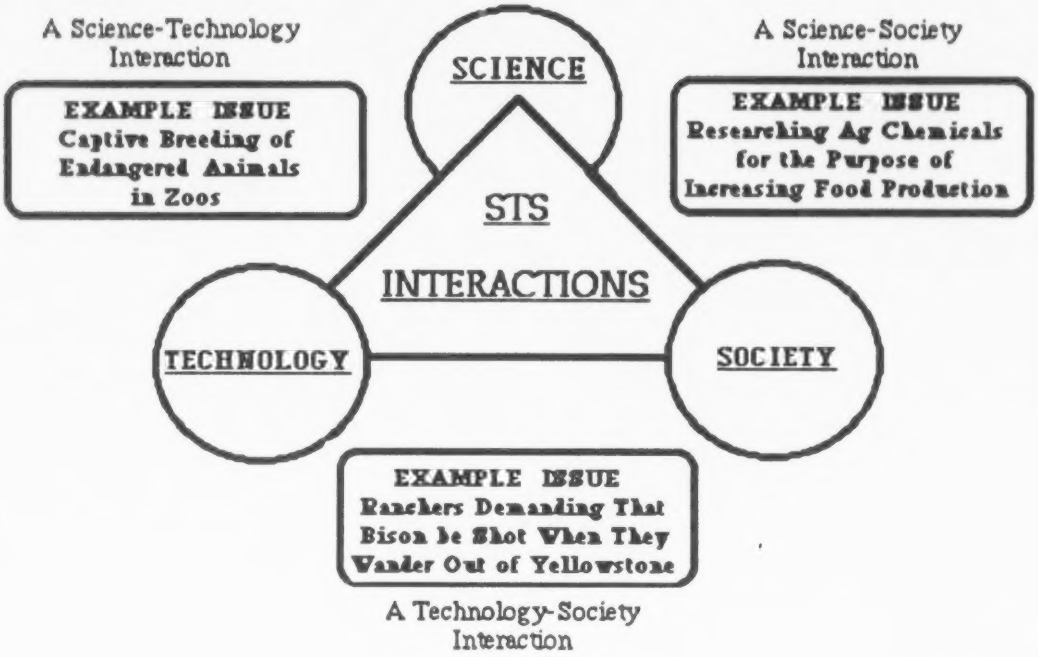
A Science-Technology Interaction
EXAMPLE ISSUE
Captive Breeding of Endangered Animals in Zoos
SCIENCE
A Science-Society Interaction
EXAMPLE ISSUE
Researching Ag Chemicals for the Purpose of Increasing Food Production
STS
INTERACTIONS
TECHNOLOGY
SOCIETY
EXAMPLE ISSUE
Ranchers Demanding That Bison be Shot When They Wander Out of Yellowstone
A Technology-Society Interaction

Figure 1. STS interactions: The bases of science-related social issues.

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Just what is E. Joseph Piel saying in that statement? We infer that the ultimate objective is for the student to become a responsible citizen in the world community and to be able to contribute to the solution of science-related social issues. If this inference is correct, there is a plethora of prerequisites that must be attended to before that citizenship component is in hand. Among these prerequisites would be: (1) the ability to identify science-related social issues; (2) the ability to analyze issues and identify the "players" (the individuals and/or groups involved in issues) as well as their beliefs and values; (3) the ability to investigate these issues so as to identify the facts surrounding them and their social, economic, political, legal, and ecological ramifications; (4) the ability to evaluate the issues and determine the most effective means of resolving them; (5) the ability to develop an "action plan" which can be implemented in an attempt to resolve or help resolve the issues; and (6) the ability to execute the action plan if it is consistent with one's personal values.

These are not instructional objectives familiar to most teachers, are they? Meeting these objectives will necessitate a great commitment on the part of the entire education community and science teachers specifically. It might be suggested that the ideal format would be for various content specialists to work together in meeting these objectives, i.e., a cooperative effort on the part of social studies, language arts, and science teachers. Regardless of the format, the citizenship outcome associated with science-related social issue instruction is a challenge of substantial proportion.

> **. . . the citizenship outcome associated with science-related social issue instruction is a challenge of substantial proportion.**

What Does Research Tell Us about Issue Instruction?

Although large numbers of studies concerning issue instruction are not available, there are enough to give us an indication of the status of such instruction and the effects produced by various approaches. Without belaboring the topic, the research indicates the following.

1) Although textbook coverage of issues is on the increase, there is a paucity of materials that cover the issues available for use by the teacher. Where issue coverage is present, it tends to be at an awareness level, without opportunity for in-depth student investigation of issues or training for responsible citizenship.

2) Issues instruction is not a prevalent approach for science instruction in today's science classrooms. Where it is found, it remains, by and large, an awareness activity. Thus, the really critical outcomes associated with issues instruction are not being realized.

3) If citizenship performance is a desired state for students, it will not be attained by teaching issues at an awareness level. In two studies, two Illinois researchers compared an awareness-level case study format with an investigation/citizenship responsibility format, and both found that the awareness-level case study format resulted in far less independent citizenship behavior than the investigation/citizenship responsibility format.

It appears, then, that issue instruction must transcend a simple awareness of issues and incorporate direct training in citizenship skills associated with issue remediation. The writers are also of the opinion that, when in-depth investigation skills are taught along with citizenship action skills, even more responsible citizenship behavior will result.

What, Then, Is the Answer?

Two separate approaches are recommended by the writers, namely: (1) the case study approach, and (2) the investigation skill approach. Each approach has certain benefits and certain problems associated with it. However, in each approach the instructor must incorporate goals that go beyond what is traditionally found in science courses. What are these goals? On the next page is a brief description of each of four recommended goals.

Regardless of the approach used in issues instruction, i.e., the case study format or the investigative skills format, these goals appear to be crucial for success. Similarly, these goals are hierar

> **Where issue coverage is present [in textbooks], it tends to be at an awareness level, without opportunity for in-depth student investigation of issues or training for responsible citizenship.**

Instructional Goals for Issues Instruction

Goal No 1: Foundations. This goal seeks to provide learners with the prerequisite knowledge needed to understand and investigate issues in depth. This knowledge would include basic content associated with the issues themselves plus knowledge associated with the nature of science, technology, and society, and their interrelationships.

Goal No. 2: The Issues Awareness Level. This goal seeks to provide learners with the conceptual knowledge associated with issues. It also involves an understanding of the "anatomy of issues," including what separates problems and issues as well as the varying beliefs and values held by members of society which impinge so heavily on the origin and resolution of issues. This goal also involves students understanding the need for them to become involved in issue investigation, evaluation, and resolution.

Goal No. 3: The Investigation and Evaluation Level: Training and Application. This goal seeks to provide learners with the knowledge and skills necessary to permit them to investigate/analyze issues and evaluate alternative solutions for resolving these issues. It also necessitates some form of student involvement in the investigative process, including data collection, interpretation, and communication.

Goal No. 4: The Citizenship Responsibility Level: Training and Application.
This goal seeks to provide learners with the skills necessary for making responsible decisions concerning the resolution of science-related social issues. Likewise, it provides learners with an opportunity to prepare and evaluate "action plans" for issue resolution. It supports the application of citizenship action strategies if and when students are motivated to apply their action plans.

(**Note:** Goal No. 4 does ***not require*** students to take action on issues, but it provides an opportunity for them to do so if they desire it. In the opinion of the writers, it is unethical for a teacher to demand that students take action on an issue when said action may run counter to the student's beliefs and values.)

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chical, i.e., they function as a continuum in a linear manner with foundations preceding awareness, etc. *Collectively, these goals encompass the knowledge, skills, and opportunities for application needed by students to understand, investigate, analyze, and evaluate issues and their solutions as well as to develop the citizenship skills necessary to help resolve these same issues.*

Formats

The Case Study.

The case study is, by and large, a teacher-directed analysis of a particular science-related social issue. It is an instructional method which utilizes both primary and secondary sources to deliver issue-focused information and skills to students. In other words, original sources are, at least initially, used by the teacher to develop a foundation of knowledge concerning the issue. Once students are oriented to the issue, the teacher provides students with the skills needed to investigate the issue on a class or small-group basis. Such a strategy could involve the students in a search for additional secondary sources of information, looking, perhaps, for subtle bits of information that can be synthesized by the class.

Or, it could involve a class decision concerning information needed or questions needing answering at the local community level. This could well lead to instruction on the development of a survey which the entire class would administer within the community. This would lead to the collection of primary data which would be recorded and interpreted within the class itself. Once class decisions are made concerning what should be done, the time is ripe for citizenship action training and the eventual development of an action plan which may or may not be implemented, depending upon the decisions made by the teacher/class.

Therefore, the case study provides the teacher with a substantial amount of flexibility and control. The extent to which the issue is dealt with is in the hands of the teacher. The teacher can choose the issue, determine the methods to be used, make decisions concerning the depth to which the issue will be studied/analyzed, select the content area in which the issue will be infused, and determine the length of time to be spent on the case study.

There is, however, a price that must be paid for flexibility and control! The costs involve time, energy, and skill in putting the case study together. Most issue case studies are a "do it yourself" curriculum with the classroom teacher as the curriculum designer. Although students can and probably should be involved in the selection of a case study, the final responsibility generally rests with the teacher. So, too, does the responsibility for finding and selecting original sources, be they video tapes, printed matter, guest speakers, panel members, films, field trips, or simulations. Decisions must be made about the specific learning outcomes desired. Handouts must be prepared. Evaluation instruments must be designed and validated. A time and sequence flowchart should be prepared delineating the instructional steps, schedule, methods, etc. The development of a good case study is certainly not an easy task.

Several additional problems are associated with the case study format. The writers do not know to what extent the case study format with the citizenship component will change student behavior in terms of citizenship responsibility. However, they are quite willing to hypothesize that the teacher will notice only little responsible citizenship behavior, if any, if the citizenship training goal is omitted. And if that goal is met, we hypothesize that citizenship action might well be observed but limited to the issue involved in the case study. In other words, case studies, because of their narrow focus, may not foster the desired citizenship behavior in other contexts.

Another problem with the case study format relates to students' interests. The teacher is not going to be able to meet the interests of all of his or her students using the case study format. This is a rather severe limitation when one has a number of students who would like to investigate issues other than the one(s) being studied in class. This limitation is counteracted using the issues investigation skills format.

Collectively, these goals encompass the knowledge, skills, and opportunities for application needed by students to understand, investigate, analyze, and evaluate issues and their solutions as well as to develop the citizenship skills necessary to help resolve these same issues.

The Investigation and Evaluation Skills Model.

The case study approach to issues investigation focuses on only one issue category, e.g., the management of grizzly bear populations in the western states or environmental issues of the Rio Grande Valley. The specific issue or issue category itself is the intent of case study instruction. As a result, the instructional activities are issue-specific. In contrast, the investigation skills methodology employs a broader, more generalizable approach to the process of issues investigation. The intent of the investigation and evaluation skills methodology is to develop in students the skills involved in issues investigation, evaluation, and resolution: capabilities which can be used throughout their lives as citizens.

Like the case study approach, the investigation and evaluation skills method uses instructional activities structured around the four issues investigation goal levels. However, unlike the case study approach, the investigation skills method defines, practices, and applies the generic knowledge and skills needed by learners to independently investigate and resolve issues. This process culminates in an investigation of an issue of the student's own choosing and the development of an action plan for resolving that issue.

The investigation and evaluation skills methodology has been formalized and published in *Investigating and Evaluating Environmental Issues and Actions: Skill Development Program* (Hungerford, et al., 1996). This program is currently in use in grades 5-12 in numerous schools across the U.S. It is also available in a Spanish language edition.

The investigation skills program is organized into a series of six chapters. The chapters are interdisciplinary in nature and introduce students to the characteristics of issues, the skills needed for obtaining and processing information, the skills needed for investigating and analyzing issues, and those skills needed by responsible citizens for issue resolution. The following description provides a very brief overview of each chapter in *Investigating and Evaluating Environmental Issues and Actions: Skill Development Program.*

The Issue Investigation and Evaluation Skills Strategy

Chapter I: An Introduction to Environmental Problems and Issues - Students discriminate among events, problems, and issues. The impact of beliefs and values on environmental (science-related social) issues is explored and issue analysis is introduced and practiced. The concept of "interaction," so crucial in the sciences and social studies, is also introduced, demonstrated, and applied.

Chapter II: Getting Started on Issue Investigation - In Chapter II students identify issues, write research questions, learn how to gain information from secondary sources and how to compare and evaluate information sources.

Chapter III: Using Surveys, Opinionnaires, and Questionnaires in Environmental Investigations - In Chapter III students learn how to obtain information using primary methods of investigation. Initially, they learn how to develop surveys, opinionnaires, and questionnaires. They also learn the basics of interviewing. Subsequently, they learn sampling techniques and how to administer data collection instruments and how to record these data.

Chapter IV Interpreting Data from Investigations - In Chapter IV students learn how to draw conclusions, make inferences, and formulate recommendations. Further, they learn how to produce and interpret graphs.

Chapter V: Investigating an Issue - *In Chapter V* students autonomously select and investigate an STS issue. This process involves the application and synthesis of the skills learned thus far.

Chapter VI: Environmental Action Strategies - In Chapter VI students learn the major methods of citizenship action, analyze the effectiveness of individual action versus group action, and develop issue resolution action plans. This "action plan" is evaluated against a set of predetermined criteria designed to assess the social, cultural and ecological implications of citizenship actions. Finally, the action plan may be implemented at the discretion of the student-again, in an autonomous mode.

This skill development approach provides a powerful vehicle for the investigation of a multitude of different science-related social issues by students. The effectiveness of this methodology was validated by the research findings which showed that this modular issues investigation training fostered responsible and independent citizenship behavior on the part of eighth grade students.

Most instructional methods, including the investigation skills approach, have a variety of problems and limitations. Teachers have typically found that a full eighteen week semester is needed to complete the instructional objectives in the skill development program. Further, a variety of classroom management skills is critical in those aspects of instruction where the teacher acts as a facilitator between resources and students in the process of investigating an array of issues. In particular, some teachers have found that it is difficult to make the transition from direct instruction to a role which demands advising and consulting. Allowing students to investigate issues independently is evidently viewed as an unfamiliar departure from traditional classroom management practice by many teachers.

How Do the Two Approaches Compare?

Both the case study and the investigation skills approaches provide instructional methods for science teachers to deal effectively with issues investigation. Both strategies share similar instructional goals and activities, but both differ in scope, teacher and student postures, instructional time demands, and a variety of other curricular and classroom management factors. Figure 2 compares the issue case study and investigation skills approaches across a number of educational characteristics or variables.

Characteristic	The Case Study	Issue Investigation Skills
Student Characteristics		
1. Grade Levels	4 - 12	6 - 12
2. The Student's Role	Mostly as a Receiver of Information and a Small or Large Group Researcher	Typically an Autonomous, Independent Researcher of Issues
3. Ability Levels	A Wide Range of Abilities	Typically Average and Above
Characteristics of Instruction		
1. Issue Focus	Single Issue Treatment: Issues are Often Chosen by the Instructor	Multiple Issues Treatment: Issues Chosen by the Students and Approved by the Instructor
2. Instructional Posture	Initially Traditional, As Investigation Progresses, the Instructor Becomes a Facilitator or Consultant to the Class or Groups	Direct Instruction w/Skill Development Followed by Issue Investigation Facilitator
3. Time Demands	Variable: Depends Upon the Case Study and Its Complexity, Often Six to Twelve Weeks	Typically One Semester or Eighteen (18) Weeks
4. Demand for Instructor Flexibility Compared to Traditional Classroom Methods	Moderate	High
5. Need for Inservice Staff Development	High	Very High
6. Potential for Infusion Into Existing Programs	Very High	Moderate: Requires Substantial Instructional Time
7. Team Teaching Potential	Moderate - High	Very High
Outcomes of Instruction		
1. Knowledge of a broad range of science-related social issues	Low	High
2. Skills Acquisition	Low-Moderate	Very High
3. Citizenship Skills Acquisition	Typically Issue-Specific	Potential for a Generic Repertoire with Significant Transfer Potential

4. Development of Out-of-School Citizenship Responsibility	It Could Be Moderate If All Goal Levels Are Covered	High
Materials		
1. Source	Teacher Constructed Unless School Purchases Commercial Case Studies	Published Worktext Available
2. Expense	If Teacher-Constructed, Relatively Low; If Commercially Obtained, $8 - $12 Per Student	Approximately $10 - $14 Per Student

Figure 2. Format comparison: Issue case study treatment vs. issue investigation and evaluation treatment.

In Closing

If science-related social issues are to become an integral part of a sound general education in science and if citizenship involvement in these issues is important, instruction on issues should include more than a simple awareness of them. It appears that a four-level, hierarchical set of goals needs to be used in the development of curricula to meet these needs, i.e., science foundations, issue awareness, issue investigation, and citizenship involvement. At least two major strategies are available for the incorporation of these goals levels. The four-level case study format appears to work well for many teachers (particularly at the elementary grade levels). The more sophisticated issue investigation and evaluation skill development strategy may be more appropriate for use with learners at grades six and above.

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Assessment In Environmental Education

Thomas Marcinkowski

The original manuscript for this reading was a classic and thorough document written by Dr. Marcinkowski for the *Environmental Education Teacher Resource Handbook* published by Kraus International Publications in cooperation with the National Science Teachers Association in 1993 (pp. 144-197). The reading that appears here which resulted from this manuscript introduces the reader to concepts associated with measurement, testing, assessment, and evaluation. In addition, it focuses the reader's attention on a goodly number of ideas associated with these concepts and educational practices as well as guidelines for applying these practices in environmental education. The original manuscript, furnished by Dr. Marcinkowski for use in this book, has been substantially abridged due to space limitations. Should you desire a more thorough treatise on assessment, you may wish to refer to the *Environmental Education Teacher Resource Handbook*.

Section I: Introduction and Overview

Defining Key Terms

Since this handbook will be used by educational professionals with quite differing backgrounds, it seems appropriate to begin with an introduction to four basic terms which appear throughout the chapter: *measurement, testing, assessment, and evaluation*. This is done to help readers understand the range of relatively current meanings which can and will be affixed to these different terms. It is also done to help readers conceptualize the similarities, differences, and relationships amongst these commonly misused terms. For the benefit of readers, two additional terms, "data collection" and "accountability", will be defined, as these terms are commonly used in conjunction with the other four.

Measurement commonly refers to both a process and a product. As a process, measurement "is concerned with the systematic collection, quantification, and ordering of data" (Payne, 1992, p. 9). In this process, humans "assign numbers to attributes or characteristics of persons, objects, or events according to explicit formulations or rules" (Sax, 1989, p. 15). As a product, a measurement is an observation presented in quantitative terms. Thus, for the purposes of this chapter, measurement refers to a systematic and quantitative form of data collection.

In its most fundamental sense, a *test* is a particular form of measurement (Payne, 1992, p. 9). Sax defines a test as "a task or series of tasks used to obtain systematic observations presumed to be representative of educational or psychological traits or attributes" (1989, p. 18). In educational settings, tests are commonly used to measure a wide range of traits or attributes, the most common of which are cognitive knowledge and skills. A set of observations obtained via the testing process is commonly used to generate some type of score. This is the sense in which the terms test and testing are used herein.

It seems that the term *assessment* is used more broadly than is test or testing. According to Mehrens and Lehman, "it is often used to indicate the use of formal and informal data-gathering procedures and the combining of the data in a global fashion to reach an overall judgment" (1991, p. 4).

At times, the term assessment is used more narrowly to refer to the process of specifying, diagnosing, and/or verifying some kind problem (Mehrens & Lehman, 1991, p. 4; Salvia & Ysseldyke, 1991, p. 3). In educational contexts, these problems tend to be academic, behavioral, and/or physical in nature. In this chapter, assessment will be used in the "data-gathering" rather than the "diagnostic" sense, unless noted otherwise.

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Thus, *assessment* will commonly refer to a purposeful data collection process, broader than both measurement and testing. ... assessment is commonly seen as an alternative to tests and testing.

The phrase "data collection" is broader than, and therefore subsumes, the terms measurement, test(ing), and assessment. In its broadest use in education, data collection simply refers to the accumulation of data through observation, interview, pencil-and-paper recording, archive retrieval, and other means. As most readers know, data collection may or may not be a systematic process. The degree to which the process needs to be systematic may be determined by the purposes for collecting the data.

The term *evaluation* refers to a process in which value-laden judgments or decisions are made (Sax, 1989; Payne, 1992). While the term "evaluation" is often used synonymously with measurement (Stufflebeam, et al., 1971, pp. 9-16), this is usually inappropriate. Measurement involves data collection, while evaluation involves the use of values to render judgments or decisions on the basis of available data.

The last terms to be defined in this introduction is *accountability*. It is included, for at least in the U.S., a movement for educational accountability has driven the need for and dictated accepted modes of testing, assessment and evaluation. To quote Mehrens and Lehman, "Accountability is in vogue in education" (1991, p. 496). According to them ...

> ... a typical definition for accountability would include setting correct goals; evaluating their degree of achievement ... and at what price; presenting and interpreting this information to the public; and accepting responsibility for any results that are perceived as inadequate. (1991, p. 497)

In this sense, accountability goes beyond evaluative judgments or decision, by including a determination of where the fault for failure may lie. This "going beyond" may involve the assumption of responsibility for performance, for affixing of responsibility for performance (i.e., offering praise or blame), and/or for making decisions on the basis of performance (e.g., rewarding or sanctioning).

There are varied, sometimes divergent meanings affixed to the key terms introduced here. The definitions presented here reflect a sample of professional educational opinion, and are not intended to be exhaustive. Rather, they are intended to provide the reader with an understanding of how these key terms will and will not be used throughout this chapter.

The Context of Assessment: Environmental Education

It is virtually impossible to discuss topics like measurement, testing, assessment, and evaluation (M/T/A/E) without placing these practices into some educational context. ... that context is the field of "Environmental Education". It is important to explore what has been and what is going on in this field (i.e., at least within the U.S.), since this will raise discussion topics that relate directly or indirectly to the why, who, how, what and when of M/T/A/E practices.

These realities can quickly complicate any discussion of M/T/A/E in EE for two reasons. First, they lead to questions regarding the influence of one or more of these trends on a program's current purposes. Many formal and non-formal programs espouse goals and objectives which appear to reflect several of these historical trends (Childress, 1978; Simmons, 1991). Quite naturally, when administrators and staff of these programs want to undertake a "program evaluation", they wish to have the full range of their goals and objectives considered. Given the variety of possible combinations of goals and objectives, the development of M/T/A/E practices relevant to "hybrid" programs can be a complex, often situation-specific, undertaking.

Secondly, it has been reasonably well established that EE programs use varying forms of "evaluation" (i.e., some forms of M/T/A/E) on a sporadic and irregular basis (Childress, 1976; Disinger, 1981). There is some evidence that this is changing, notably in states which have established EE testing/assessment procedures, though the number of states which have done so is limited. More significantly, the available data indicate that EE programs which identify their primary focus as nature study, outdoor education or conservation education have been found to use "evaluation" less frequently, are more prone to use informal or subjective methods, and are highly likely to emphasize participant satisfaction or attitudes, if they report using any form of "evaluation" at all (Disinger, 1981; Chenery & Hammerman, 1984/ 85). These studies indicate that "evaluation" has not been made a priority, and that the need for meaningful support in the area of M/T/A/E is great.

... recent and forthcoming discussions of educational reforms emphasize the role of standard setting and assessment relative to standards as critical to the transformation of classroom practices on a broad, national scale (National Council of Teachers of Mathematics, 1989; National Research Council, 1993; Simmons & Resnick, 1993).

Section II: Some Decision Guidelines for Measurement, Testing, Assessment, and Evaluation: Why, What, and How

This section will provide responses to three basic questions one encounters when making M/T/A/E decisions: why, what, and how.

Why?

The question "Why?" subsumes the questions "Why do we measure?", "Why do we test or assess learners?", and "Why do we evaluate?". Responses to these "why" questions can be offered from many perspectives, including philosophical, historical, political, economic, and practical ones. For example, some would argue that we have had a preoccupation with quantitative measures and tests as a result of the philosophical dominance of the scientific tradition in the way we have come look at the teaching/ learning and assessment/ evaluation over the 20th century. It is difficult to argue with this premise, since it has become so widely accepted (e.g., see Haney & Madaus, 1989, pp. 683-684; Thorndike, Cunningham, Thorndike, & Hagen, 1991, pp. 2-6).

Popham, one prominent harbinger of this movement, offers the following response to "why":

> It doesn't take too much insight on the part of teacher to realize that if objectives are specified in terms of measurable learner behavior, there exists the possibility that the instructor will have to become accountable for securing such behavior changes. Teacher[s] might be judged on their ability to bring about desirable changes in learners. They should be ... He (the teacher) will no longer be judged on the idiosyncratic whims of a visiting supervisor. Rather, he can amass evidence that, in terms of pupils' actual attainments, he is able to
>
> teach effectively. (Popham, 1969, as cited in Worthen & Saunders, 1973, pp. 244-245)

To whom would these teachers be accountable? They would certainly be accountable to the parents of children they teach. As employees of a public school district, they would also be accountable to building, district, and in a less tangible sense, state education agency officials. Unfortunately the manner in which teachers are often held accountable is not as Popham envisioned - a system of competency-based tests derived from performance objectives (i.e., criterion-referenced tests). Rather, teachers are often held accountable for their students' performance on standardized, or norm-referenced tests which have been adopted by state education agencies and legislatures.

> In contrast to testing in many other countries, testing in the U.S. is primarily controlled by commercial publishers and nonschool agencies that produce norm-referenced, multiple-choice instruments designed to rank students cheaply and efficiently. (Darling-Hammond, 1991, p. 220)

Darling-Hammond's response points out the basic economic reason "why" we test as we do today: (a) we do so because testing has become a rather large and profitable business for established companies; and (b) for state agencies and district officials, such tests are a "cheap and efficient" means of meeting state mandates for comparative data and accountability.

These responses to the questions "why" represent a first step in analyzing factors which have contributed to current practices in M/T/A/E in formal, and to a lesser extent, non-formal settings in the U.S.

From a more practical perspective, the "why" question becomes "Why should we, or do we, engage in M/T/A/E?". In assessment and evaluation circles, this is commonly discussed under headings such as "Purposes," "Roles," and "Decision Settings". Varied responses have been offered by "experts" working in these areas. Some responses reflect common facets of educational programs:

- To select, appraise, and clarify goals and objectives;
- To judge the intellectual integrity and sequencing of contents (i.e., including subject matter, skills, and so on);
- To select, appraise, and modify instructional materials;
- To plan, direct, and improve instruction and/or learning experiences;
- To determine what students have learned, both against and apart from stated objectives; and

- To determine how students perceive, react to, and have been influenced by their experiences (Stake, 1967, as reprinted in Worthen & Saunders, 1973; Alkin, 1969, as reprinted in Worthen & Saunders, 1973; Provus, 1969, as reprinted in Worthen & Saunders, 1973; Scriven, 1973; Bennett, 1984; Chenery & Hammerman, 1984/85; Payne, 1992).

Other purposes reflect stages of development and/or decision regarding whole print, audio-visual, and [especially] instructional programs:

- To assess needs, problems, and opportunities within the arena served by a program;
- To help guide the planning and implementation of new programs;
- To improve a program once it has been implemented or adopted;
- To determine the acceptability or acceptance of a program (i.e., amongst educational partners);
- To determine the worth of a program (i.e., against some set of criteria or standards or by some set of judgments);
- To determine the comparative worth of a program (e.g., against a prior or alternative version of the program, or against a different program); and
- To determine the cost-effectiveness of a program (Stake, 1967, as reprinted in Worthen & Saunders, 1973; Alkin, 1969, as reprinted in Worthen & Saunders, 1973; Stufflebeam, et al., 1971).

There are few data available which indicate "why" M/T/A/E are actually undertaken in EE and related programs. ... Chenery and Ham-merman (1984/85, p. 38) ... found that program and staff improvement, planning future programs, determination of program accomplishments, and staff rehiring were the most common reasons for collecting M/T/A/E data.

What?

It is almost impossible to discuss the "why" question without talking about what kinds of data are to be collected, and what kinds of phenomena are of interest in the data collection process (i.e., "What gets measured, tested, assessed, or evaluated?"). ...

Many "models" have been generated and published which represent "what" may be of interest in a M/T/A/E setting. In the vast majority of cases of relevance to EE, M/T/A all focus upon the "student learning" component of these models: capabilities, processes, and outcomes. Thus, it is only evaluation [E] which offers a broad response to the "what" question. To help readers make sense of where student learning fits, a hybrid model adapted from several sources in the EE literature is presented in Figure 1 (Bennett, 1977, p. 198, 1982, p. 14; Miles & Robinson, 1979, p. 27; Hungerford & Peyton, 1986, pp. 32-38). This model is intended to portray the basic relationships between T/A/E activities and common foci of T/A/E activity (i.e., "whats").

This model will serve as the basis for identifying and describing several of the more prominent "whats" of T/A/E of interest to EE.

A. Needs

A needs assessment can be used to identify and qualify "needs" to be addressed in and through a particular program. These usually include current and/or projected needs of the learners, but can also include needs of teachers, program, supporters and community, and other entities whose interests are served in and through a program.

B. Goals and Objectives

Two sub-components were identified: (1) Curriculum Goals; and (2) Instructional Objectives. The goals to be addressed in a program (or the goals of a program) serve as tools for organizing and guiding decisions about curricular and instructional practices. They frequently serve as the basis for drafting more specific instructional objectives. Like goals, objectives "are critical to the entire process of curriculum development and instruction. This component establishes what the learner is to learn, (i.e., what the instructor is to teach") (Hungerford & Peyton, 1986, p. 34). Testing/assessment can be used to monitor students relative to these objectives prior to (pre), during (formative), and following (post) instruction,

C. Instructional Planning

Three sub-components were identified: (1) Learning Theories and Instructional Designs; (2) Content Selection and Organization; and (3) Learning Resources and Environments. Of these, the (2) and (3) are more commonly targeted in evaluations. With respect to (2), "content" refers to subject-matter, cognitive strategies, cognitive skills, affec

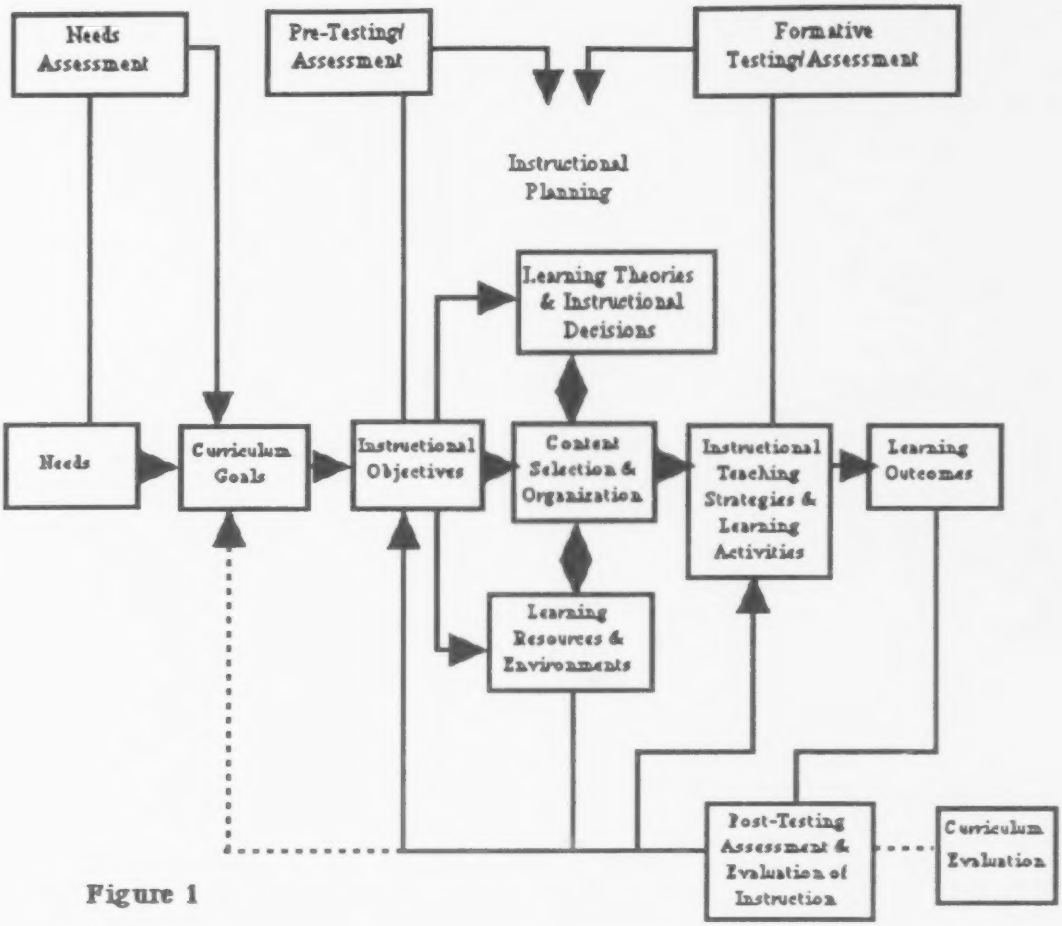
Needs Assessment
Pre-Testing/ Assessment
Formative Testing/Assessment
Instructional Planning
Learning Theories & Instructional Decisions
Needs
Curriculum Goals
Instructional Objectives
Content Selection & Organization
Instructional Teaching Strategies & Learning Activities
Learning Outcomes
Learning Resources & Environments
Post-Testing Assessment & Evaluation of Instruction
Curriculum Evaluation

Figure 1

tive skills, affective dispositions (e.g., sensitivity, values, efficacy), and behaviors emphasized in a program. ... With respect to (3), "resources" refers to the wide array of manipulatives, print materials, and computer and audio-visual resources commonly used for teaching-and-learning purposes. These have been common objects of evaluation or evaluation interest in EE (e.g., Stevenson, 1984; Pomerantz, 1990-91; Rohwedder, 1992). As a result, a number of resource evaluation tools have been developed for use in EE (e.g., Gardella, 1987; Wilson, 1990; Marcinkowski, Volk & Hungerford, 1990). Further, "environments" refers to the variety of physical settings in which EE instruction takes place.

D. Instruction

Two sub-components are identified: (1) teaching strategies; and (2) learning activities. The first refers to the strategies (or methods) actually used by teachers in the course of their instruction. There has been substantial interest in EE in the comparative evaluation of two or more strategies as they affect selected learning outcomes (see Iozzi, 1981). The second refers to the nature of student activity in the teaching and learning process. Bloom et al., (1956), Hunter (1982), NCTM (1989), and an impressive array of educators advocate active student learning and application of learnings as integral parts of this process.

E. Learning Outcomes

Learning outcomes refers to the full range of actual cognitive, affective and conative changes in students which have come about as a result of teaching and learning activity. Those which are often of greatest interest are those outcomes included in models of environmental literacy (e.g.,

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knowledge of ecology and of environmental problems/issues; skills associated with the identification, investigation and resolution of problems/ issues; environmental dispositions such as sensitivity, values, and personal efficacy; participation in service/action projects) (Unesco, 1978; Hungerford, Bluhm, Volk & Wise, 1991; Roth, 1992).

How?

The "how" question subsumes a number of relevant questions. One of the most basic and practical of these is: "How can information/data be collected?". The responses to this question are many. They are offered in texts on "Measurement and Evaluation" (e.g., Mehrens & Lehman, 1991; Thorndike, et al, 1991; Payne, 1992), "Assessment" (e.g., Salvia & Ysseldyke, 1991), "Research and Evaluation" (e.g., Isaac & Michael, 1983), and "Research" (e.g., Best, 1981; Borg & Gall, 1983; McMillan & Schumacher, 1989). Each of these types of books offers a response from the perspective of that particular area of practice, while each book tends to organize its response to this "how" questions a bit differently. While there is no "correct" way to organize a response, it is important to do so in a way which attempts to minimize confusion.

Perhaps the simplest response to this question involves the identification of the basic methods of data collection:

- pencil-and-paper: asking individuals to record information on paper. Given the increasing use of technologies which replace paper (e.g., computers), these may be seen as an outgrowth of pencil-and-paper approaches;
- observation: collecting observations of objects, people and/or events;
- interview: asking individuals questions and recording their responses ;
- use of records and archives: collecting information about objects, people, and/or events from some form of record; and
- combinations of two or more of the above: asking people to record their own observations or interview responses using pencil-and-paper.

In a fundamental sense, these are the most basic approaches to data collection. Nearly all other methods of data collection commonly used in M/T/A/E settings involve one or more of these.

Section III: Alternative Assessment

Introduction

Within the literature, reasonable efforts have been made to present overviews of M/T/E, and to show how these tend to be approached in EE (e.g., Bennett, 1977, 1982, 1984; Passineau, 1984; Iozzi, Laveault & Marcinkowski, in press). These practices will not be reviewed here. However, one area which has received limited attention within the EE literature is assessment, notably "alternative assessment." Thus, the remainder of this section will feature the non-testing or "alternative" forms of assessment which fall under various headings: "direct," "performance," "practical," and "authentic." For these kinds of assessment procedures, the "how" question focuses upon how: they are developed or organized; they are administered, collected or recorded; they are rated, scored, or graded; and how the results are used.

> A point worth noting about evaluation alternatives that have been suggested over the last 20 years is that many of them are not at all new. Evaluation tools such as live performance, products, teacher judgments, and school grades have a long history in education. (Haney & Madaus, 1989, p. 685)

While many readers will recognize that some kinds of assessment have been in use for some time (e.g., lab practicals, oral exams, art portfolios), it is important to recognize there is renewed and highly creative interest in these alternatives to testing. Hence, there is innovation in the development and use of such assessments at all levels across the country.

The range of alternative assessments under consideration and use is quite broad. According to Darling-Hammond:

> Much like the assessment systems that prevail in many other countries, these approaches include essay examinations, research projects, scientific experiments,

> exhibitions, and performance in such areas as debating and the arts. They also include the use of portfolios of students' work in various subject areas and projects that require analysis, investigation, experimentation, cooperation, and written, oral, or graphic presentation of findings. (1991, p. 223)

It is quite likely that professionals who participate in the development of alternative approaches will encounter difficulties with this rapidly growing area of assessment (Worthen, 1993). One of these is its conceptual clarity: "... it becomes nearly impossible to synthesize or summarize what has been said (about alternative assessment) without risking distortion and oversimplification" (Worthen, 1993, p. 447). At the risk of over-simplifying these approaches, effort will be made to present readers with two frameworks which can be used to make sense of these approaches from a practical perspective.

The first framework is broad, and identifies three general contexts in which assessments are conducted. These are:

- a student's performance is observed in the course of her/his everyday activity (natural activity, natural setting);
- a student is presented with an assignment by the teacher, and her/his performance is observed as she/he carries out that assignment (structured activity, natural setting); and
- a student is presented with a task to complete in a test-like setting, and performance is observed as she/he carries out that task (structured activity, structured setting).

The educational contexts in which these can be applied vary from one to another. The first context reflects classroom settings where the primary end served by performance assessment is teaching and learning. The second context reflects classroom, school and district settings, though this depends upon the assignment, the setting of the performance, and the observers/ raters present. ...

The third context is more commonly associated with larger scale and comparative assessments. ... The third kind of analysis tends to place more emphasis upon the improvement of practice that do the first two. Note that the purpose for assessment guides how samples (or responses) are analyzed.

Since the distinctions amongst "processes", "products" and "performances" can easily become blurred (e.g., processes and performances can be recorded and become part of a portfolio), it is easier to present a simpler grouping of types. Feuer and Fulton (1993) have identified seven "types". Five of their seven types are: (a) manipulative tasks and investigations; (b) writing samples; (c) oral discourse and examination; (d) exhibitions; and (e) portfolios. The remaining two types, "constructed-response items" (short answers) and "essays" ... will not be addressed here. The only possible exception to this is the inclusion of a non-traditional assessment tool: (f) concept mapping. It may be important to reiterate that the above can serve as sound alternatives to standardized tests.

Manipulative Tasks and Investigations

These are most commonly used in the areas of science, mathematics, and social studies, and for the assessment of knowledge and/or skills. The applications in science are commonly referred to as "authentic assessments". Here,

> activities to be assessed include developing hypotheses, planning and carrying out experiments [scientific investigations], writing up findings, using the skills of measurement and estimation, and applying knowledge of scientific facts and underlying concepts - in short, "doing science". (Feuer & Fulton, 1993, p. 478)

Investigations of social conditions, problems and issues which occur in social studies programs have some structural similarities to scientific investigations. For example, many scientific inquiry and critical thinking skills also appear in charts of skills to be taught within the social studies (NCSS, 1984, 1989). Consequently, the kinds of tasks presented in authentic assessments in science can be applied within the social studies. ... Since there is a long-standing tradition of using manipulatives within the mathematics, it also appropriate to use a series of manipulative tasks for assessing mathematics knowledge and skill. ... Applications in EE could include the use of a series of carefully sequenced tasks for assessing students' ability to analyze data/information associated with any of the phenomena of ecological/environmental interest (i.e., including populations, systems, resources, problems, issues, alternative solutions, or actions).

Writing Assessments

These usually involve the collection of one or more samples of student writing. This type of assessment may grow out of any of the three natural/structured contexts (e.g., of samples generated by students who regularly use the writing process, as a special assignment, or as a state level assessment). ... Applications in EE could include the use of a rubric for scoring both language arts and subject matter dimensions of written reports which students' generate from their investigations of phenomena of ecological/ environmental interest.

Oral Discourse and Examination

According to Feuer and Fulton (1993), this is "the earliest form of performance assessment" (p. 478). Many graduate schools across the country use some form of oral comprehensive exam, or oral defense of a thesis. This allows faculty to explore a student's knowledge, skills and views in a flexible, yet detailed fashion. At the other extreme, oral questioning is often used with children at the early childhood level, in part due to limitations in their writing ability. This allows each child to both present and explain their ideas. Between these grade levels, oral methods are commonly used to assess students' lines of thinking and reasoning (Driver, Guesne, & Tiberghien, 1985, p. 200; Osborn & Freyberg, 1985, pp. 92-99), and their construction and presentation of positions in debates and defenses. ... Applications in EE could include the use of rating forms to assess oral presentations of proposals and/or reports associated with their analysis, investigation, and evaluation of phenomena of ecological and environmental interest. It could also include the use of oral exams to assess students' knowledge of specific ecological and environmental contents (e.g., in class, lab or field settings). ...

Exhibitions

According to Feuer and Fulton, exhibitions "are designed as comprehensive demonstrations of skill or competence" (1993, p. 478). These demonstrations can involve live demonstration or performance, as is common in the language and performing arts. They can also involve exhibitions of work products, as is common in the fine arts (e.g., senior shows), in science (e.g., science fair projects), and in other subject areas in which single or multiple products are prepared by students. These often "require a broad range of competencies, are often interdisciplinary in focus, and require student initiative and creativity" (1993, p. 478). Assessment of exhibitions of performances or products requires the establishment of appropriate "standards of excellence", the training of teachers or other judges to use those in scoring exhibitions ... It could also include the assessment of fine art exhibitions (e.g., photography, drawings, paintings, sculptures and so on) against standards which reflect both artistic and subject matter criteria. It could also include the assessment of ecological/environmental projects within a science fair context, or at a strictly environmental one (e.g., those on display at a regional or statewide "Youth Earth Summit").

Portfolios

A fifth type of alternative assessment involves the development and use of portfolios. A portfolio is commonly recognized as a systematic collection of a single student's work over time (Tierney, Carter, & Desai, 1991). ... portfolios can be used in the fine arts and language arts (e.g., writing) ... . There are several ways in which portfolios are commonly used for assessment purposes. First, students must evaluate their own work. This is commonly accomplished in two ways: (a) through the thoughtful selection of work products to be placed in the portfolio; and (b) through the inclusion of a written description, reflection, and evaluation summary for each selected work product. Second, fellow students may be involved in the selection and/or written evaluation process. Third, teachers can become involved in portfolio assessment in several ways. They can support the selection process through the establishment or explication of standards for assessing products. They can develop and oversee the self- and peer-evaluation process. They can also meet with each student on an annual and/or an end-of-program basis to review with that student the evolution of their thinking, perspectives, and abilities.

[Portfolio] applications in EE can include work products resulting from ecologically - or environmentally - related classroom, lab, or field activities (e.g., analyses of problems, issues and/or action; reports of field studies, investigations or action/service projects; articles for school or public media). It can also include any of the other kinds of materials used to document quality efforts in EE (e.g., photographs of exhibits, tapes of presentations, evaluations, and awards).

Concept Mapping

A final type of alternative assessment commonly used in science education is concept mapping. While previous types of alternative assessment may require some background on the part of users, concept mapping will require specific training. Training should enable teachers and their students to understand and appropriately use concept mapping for assessment purposes. In simple terms, a concept map is a visual tool for depicting relationships amongst a set of related concepts. The manner in which these relationships are represented distinguishes concept mapping from other visual mapping tools (e.g., flow charts, semantic mapping, bubble maps). Concept maps are "intended to represent meaningful relationships between concepts in the form of propositions", and usually contain "a set of concepts embedded in a framework of propositions" (Novak & Gowin, 1984, p. 15). [Figure 2 is an example] of a concept map (Brody, Chipman, & Marion, 1988-89, p. 35).

The use of concept mapping as an assessment tool in science education began in the 1974-1977 period (Novak & Gowin, 1984, p. 95). In some studies, students were taught to construct concept maps, and then asked to construct concept maps for assessment purposes. In others, students were interviewed, had their responses taped, and then had their responses analyzed against a teacher-constructed concept map of the material covered in the interview. Readers interested in learning more about concept mapping in general, and as an assessment tool in specific, are encouraged to consult the literature (Novak & Gowin, 1984, Chapters 2, 4 and 5).

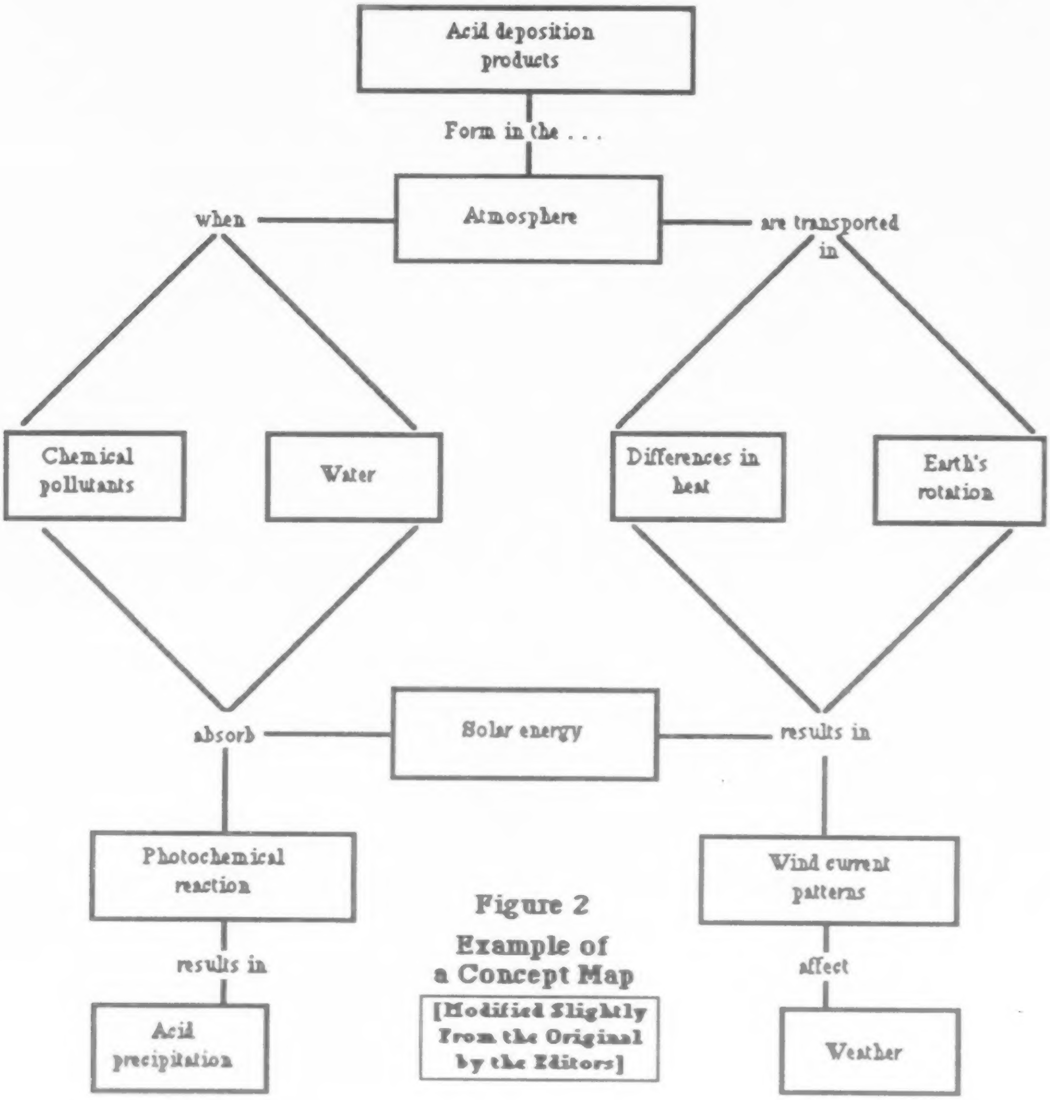

Figure 2

Example of a Concept Map

[Modified Slightly From the Original by the Editors]

Alternative Assessment in EE

There are a number of good reasons for developing and using these types of assessment in EE. First, these methods can make it easier for students to demonstrate learning relative to goals and objectives in EE. For example, when students are involved in the investigation of a problem such as water quality, or of an issue such as a controversy over predator reintroduction in their region, they will often be acquiring information and applying skills in real life settings. Skill in water quality monitoring can be best assessed in a field and/or lab setting by observing students as they collect and analyze samples. Similarly, skill in issue investigation can be best assessed by observing students as they plan, conduct and report on an investigation. In both settings, the investigation process can be taped, while the resulting information and skill can be represented in oral and/or written reports (e.g., with concept and vee maps). A similar assessment may be made of strategies and skills associated with action/service projects (i.e., as students study, plan, carry out, and evaluate their own projects).

Second, as most readers know, EE is rarely taught as a separate subject in schools. Rather, the subject matter, skills, and dispositions associated with EE goals are commonly infused into the more traditional school subjects. While infusion is most often undertaken in science and/or social studies (Disinger, 1981), EE can cut across all subject areas (e.g., see indexes in the Project Learning Tree and Project WILD Activity manuals). This is particularly true at the K-8 level, where teacher work in self-contained classrooms in all subject areas or in teams teaching situations. In schools which feature infusion, practical or authentic assessments (e.g., science and math), performance assessment (e.g., language arts, social studies), portfolio assessment (e.g., the arts), and concept and vee mapping (e.g., science, potentially social studies) could help capture the variety and richness of an EE program taught across subject areas.

Third, since EE has rarely been taught as a separate subject, less attention has been given to the development of standardized testing programs for EE. While some states have begun to develop testing programs, there are few models and limited experience in EE to guide these efforts. ...

No effort has been made to disguise the fact that the process for developing, implementing and monitoring an alternative assessment will require extensive time and energy. With all that has been said about alternative assessments here, it is only fair to point out that there are also limitations and concerns associate with their development and use (e.g., see Cizek, 1991; Maeroff, 1991; Worthen, 1993).

Section IV: Measurement, Testing, Assessment, and Evaluation of Outcomes in EE

Editor's Note: Section IV has been developed by Dr. Marcinkowski in such a way as to give the reader examples of both test and assessment items as well as scenarios and learner objectives related to each sub-section. In order to meet the editorial confines of this book of readings, Section IV has been sharply abridged which results in the omission of some of the items originally found in the manuscript. Any abridged material which appears to lack certain components of the M/T/A/E (measurement, testing, assessment, and evaluation) complex is probably a consequence of editorial prerogative and not of omission by Dr. Marcinkowski.

Since this is such a broad topic, this section will include background on and examples of approaches which have been taken to M/T/A/E's [measurement, testing, assessment, and evaluation] four basic categories of outcomes in EE: (A) knowledge; (B) skills; (C) dispositions; and (D) environmental behavior (Unesco, 1978; Roth, 1992). ...

A review of the Tbilisi "Categories of Objectives" (Unesco, 1978) and "Goals for Curriculum Development" (Hungerford, Peyton, & Wilke, 1980), and other models of environmental literacy indicate that there are basically three bodies of environmental knowledge which are commonly taught and learned:

- foundational knowledge in the natural sciences, including knowledge of ecological concept and principles;
- knowledge of environmental problems and of issues associated with them (i.e., bio-physical impacts or threats, and socio-political controversies surrounding problems);
- knowledge of environmental problem-solving and action strategies, and of issues (controversies) associated with them.

In addition, ... there has been increasing attention given to a fourth body of knowledge in EE: "foundational knowledge in the social sciences, to include history, physical and cultural geography, political science, economics, sociology, and psychology". Within EE, emphasis is given to those concepts and principles which inform our understanding of human-environment interactions in general, and environmental problems, issues and solutions in specific.

... Items and strategies [here] are presented in the form of examples. Each example [which follows] will include instructional objectives, a brief description of a teaching and learning context, and both sample test items and assessment strategies.

Example 1. Ecological Knowledge

Sample Objectives: Upon completion of instruction, students will be able to ...

- define the term "habitat;"
- identify the common habitat of a wide variety of terrestrial and aquatic organisms;
- define the term "niche;"
- describe characteristics of the niche of a variety of terrestrial and aquatic organisms;
- distinguish between "habitat" and "niche."

Teaching and Learning Context: In a middle school life science course, students have learned concepts and principles pertaining to individuals, populations, biotic interactions, communities, and abiotic interactions. In this segment, they have been exposed to textbook and lecture material, videodisc examples, and simulation game and field activities designed to address stated objectives.

Sample Test Items

• Ecologists often employ analogies and metaphors when teaching difficult concepts. Which of the following terms can be used as an analogy for the term "niche"?

a. occupation
b. habitat
c. role
d. address
e. both a and c
f. both b and d

• The following columns include a list of different habitats (left) and different organisms (right). Place the letter for each organism in the blank space next to the kind of habitat in which it is most commonly found.

______ 1. Oak-Hickory forests
______ 2. Freshwater streams
______ 3. Coniferous forests
______ 4. Short grass prairies
______ 5. Freshwater ponds
______ 6. Mountain fields

a. Gophers
b. Marmots
c. Otters
d. Red squirrels
e. Muskrats
f. Grey squirrels

• Provide evidence in support of the following statement: "It appears that some hawks and owls share the same habitat, but occupy different niches."

For the first part of this statement, identify common features of the habitat of these two birds. Be as specific as you can.

____

For the second part of this question, identify and describe characteristics which differentiate between the niches of the these two types of birds. Again, be as specific as you can.

____

Sample Assessment Approaches

- Given descriptions and/or illustrations of animals, the student will describe the habitat requirements of each. For this type of assessment, the student may be presented with a structured response form, such as the one below.

Organism A: ____

Population Companionship Requirements: ____________________________
Spatial Requirements: _______________________________________
Food Requirements: ____
Water Requirements: _______________________________________
Nesting/Denning Requirements: _________________________________
Shelter/Protection Requirements: _______________________________

NOTE: On a structured response form, the teacher may choose not to identify common habitat requirements such as those identified above, to identify some and have students identify others, or simply leave a predetermined number to be identified by the student (e.g., "Identify four requirements ..."). This kind of assessment decision should take into consideration the objectives, students' prior knowledge, and teaching and learning activities designed to address those objectives (adapted from Missouri Testing and Evaluation Service, Grade 7, 1987, p. 56).

- A second alternative assessment approach involves students in the collection of field observations. One example of a series of questions designed for this purpose is "The Ecosystem Observation Worksheet" (Hungerford, Volk, Dixon, Marcinkowski, & Sia, 1988, pp. 101-102; Marcinkowski, Volk, & Hungerford, 1990, pp. 96-99). The following questions were drawn from this worksheet. [Two new items have been added by the author and a number of the original items have been deleted in order to conserve space.]

1. What kind of ecosystem is this?

2. Is this ecosystem a dominant (extensive and typical) one in the region in which you live? Yes____ No____ Unsure____. Why did you respond as you did?

5. What are the abiotic (nonliving) variables that seem to affect this ecosystem? What is your evidence?

6. What species populations of plants and/or animals can you observe here? What is your evidence?

NEW. Of the animals you observed, which rely upon this system as their primary habitat and which do not? Again, what is your evidence?

8. Is there evidence that layers or zones of life exist in this particular system? Yes ____ No ____. If yes, how would you describe them? (If layers or zones do exist, you may wish to sketch and label them on a separate sheet of paper.

NEW. Do any of the animals you observed rely upon one of these layers or zones to meet its needs (i.e., as its habitat)? Yes ____ No ____. If yes, identify each animal and its associated layer or zone below.

Example 2. Knowledge of Environmental Problems and Issues

Sample Objectives: Upon completion of instruction, students will be able to ...

- identify ten different energy resources commonly used by humans over the course of this century, and the ways in which those resources were used;
- estimate the availability and rate of use of five of those energy resources;
- define what is meant by a "renewable", "non-renewable" and "inexhaustible" energy resource; and
- classify examples of energy resources as renewable, non-renewable and/or inexhaustible.

Teaching and Learning Context: In a secondary level year long survey-type environmental science course, students have already covered units on ecology, and on land, water, soil, agricultural, forestry, wildlife, and mineral resources. In the unit on energy resources, students have already been exposed to the laws of conservation of matter and energy, and of thermodynamics. In this segment, they have been exposed to textbook, lecture and videodisc material designed to address stated objectives, have collected information from a secondary investigation of the status of a select energy source and from a primary investigation of energy consumption/conservation in their home and community, and have taken part in field trips to regional power plants and sites.

Sample Test Item

* Below you will find a list of energy resources.

I. Coal
II. Tides
III. Winds

IV. Nuclear fission
V. Geothermal
VI. Ocean currents

Which of these energy resources are considered to be non-renewable?

a. I only
b. IV only
c. I and IV only
d. I and V only
e. I, IV and V only

Which of these energy resources cannot be traced directly back to our sun?

a. None (They all can)
b. IV only
c. IV and V only
d. II, IV and V only
e. II, IV, V, and VI only

NOTE: Both of these items are commonly referred to as "compound multiple choice" items. The key to these items is the list of examples prepared, and the concepts for which these serve as examples. In this case, the same list is used to test students' knowledge of two related, though different concepts. The number of examples and number of possible responses should reflect students' experience and developmental abilities.

Sample Assessment Approaches

* One of the student-centered "teaching and learning" activities within this unit on energy resources involved students in the investigation of national and global dimensions of energy resource reserves and usage patterns

through the use of source material (e.g., World Watch Institute's annual State of the World, World Resources Institute's biennial World Resources, U.S. Department of Energy data, information solicited from other energy organizations and companies). The steps involved in planning, conducting, and reporting this kind of secondary investigation provide adequate opportunity for monitoring (formative evaluation), assessing (summative evaluation) and grading students (Hungerford, Litherland, Peyton, Ramsey, & Volk, 1992, pp. 130-135). In specific:

- Following the preparation of their investigation plan, the students may "contract" with their teacher to provide pieces or initial drafts of their work by specified target dates (e.g., identify a resource, prepare a list of source materials, present global and national data on reserves in written and graphic form, etc.);
- Teachers use these "contracts" to monitor student progress and provide constructive feedback on smaller pieces of student work over time; and
- Students present their "final report" of their investigations in written form for assessment and grading purposes (i.e., according to assignment specifications).

* The same basic strategy can be applied to the assessment of students as they plan, conduct, and report their primary data collection on energy consumption/conservation in their home and in a select portion of their community. Since primary data collection permits students to generate new information, it is common for results of these investigations to be presented in both written and oral form, as the latter permits students to share this new information. Oral presentations are commonly assessed and/or scored by two or more observers using a common rating form. The use of multiple observers tends to reduce the potential for bias by a single observer. A sample from such a form is presented on the facing page (adapted from Hungerford, 1989). Oral presentations may be taped. Tapes can be used for immediate assessment and grading purposes, and, if so chosen by the student, included in his/her portfolio (i.e., as part of a portfolio assessment).

Example 3. Knowledge of Solutions and Action Strategies

Sample Objectives: Upon completion of instruction, students will be able to ...

- identify the environmental effects or consequences of human actions or interactions with the environment;
- classify those effects as environmentally positive, negative, or neutral/passive;
- identify at least two reasons why it may be difficult to classify effects or actions in this manner;
- identify and describe five categories, or modes of positive "environmental action"; and
- identify a minimum of three examples of actions which fall within each of these categories.

Teaching and Learning Scenario: Middle school teachers who have completed a "training workshop" on and chosen to implement the curricular program Investigating and Evaluating Environmental Issues and Actions (Hungerford, et al., 1992) commonly teach to these objectives within the last modular unit in that program. Prior to this, students have had the opportunity to develop and apply skills in problem and issue identification/definition, issue analysis, secondary and primary issue investigation, and data interpretation. In this unit, they have been exposed to worktext readings and exercises, brainstorming and discussions on what constitutes "action", group analysis and discussion of media stories about publicized "actions", and the categorization and discussion of suggested actions in contemporary action anthologies (e.g., "Simple Things Kids Can Do to Save the Earth").

Oral Report Assessment Form

Name(s): ______________________ Observer: ________________

Focus of the Investigation: ______________________________________

Criteria	Possible Points	Points Earned
Presenters will be assessed on their . . .		
1. . . . selection, definition, and narrowing of an investigation topic	6	____
2. . . . identification of variables and research questions	6	____
3. . . . sampling and data collection methods	6	____
4. . . . organization and presentation of data	6	____
5. . . . data interpretation (conclusions, inferences, recommendations)	8	____
Presenters will also be assessed on the . . .		
6. . . . organization and substance of the presentation	6	____
7. . . . quality of the oral delivery	6	____
8. . . . quality of the AV materials and presentation	6	____
Total Points:	**50**	____

Sample Test Items

* Below you will find a list of statements which represent human activities, or interactions with the environment. As you read over each, think about the environmental effects (consequences) of each. In the space adjacent to each, write in: + for a positive effect, - for a negative effect, and 0 for neither a positive nor a negative effect upon the environment.

_____ 1. A rich person buys a coat made of real leopard skin.

_____ 2. A young couple decides that they want a large family because they love children.

_____ 3. A shopper buys soda (pop) in aluminum containers because they can be easily recycled.

_____ 4. A rural land owner realizes that the old car can't be repaired and pulls it into the weeds behind the barn.

_____ 5. In order to get better gas mileage, the neighborhood mechanic bypasses the car's catalytic converter.

NOTE: The list of statements should include a balanced number of positive and negative statements, and a smaller number of neutral/passive ones (adapted from Hungerford, et al., 1992, p. 143).

* Below you will find the names of five "categories" or "modes" of positive environmental action. Following each is a space in which you are to write a definition for that category. In addition, you are asked to identify two examples of actions which clearly fit within each category.

Consumer Action: ______________________________
Example #1: ______________________________
Example #2: ______________________________

Ecomanagement (Physical Action): ______________________________
Example #1: ______________________________
Example #2: ______________________________

Persuasion: ______________________________
Example #1: ______________________________
Example #2: ______________________________

Political Action: ______________________________
Example #1: ______________________________
Example #2: ______________________________

Legal Action: ______________________________
Example #1: ______________________________
Example #2: ______________________________

NOTE: In the materials (Hungerford, et al., 1992), the category "Legal Action" was dropped as many legal actions require greater expertise or resources. Some, such as reporting violations of environmental laws, do not. It is up to the teacher to decide if her/his students would benefit from instruction in low-risk/low-cost legal action (e.g., at the secondary or college level).

Sample Assessment Approaches

* The teacher presents students with an article, or a portion of an article from the news media which reflects human interactions with the environment. The students are then asked to read their article, and respond to four questions:

- What effect(s) has this action had, and which do you think it will have with respect to the environment?
- On what information in this article do you base your response to the previous questions?
- Would you categorize this action as having positive, negative, mixed, or neutral/ passive effects with respect to the environment?
- On what criteria do you base your categorization?

* Following the completion of an issue investigation and a sequence of teaching and learning activities designed to address the objectives, a teacher will engage students in the consideration of a course of action which may be appropriate and available. Students begin by brainstorming a list of "possible actions" or "alternative solutions" for the issue they've investigated. For assessment purposes a teacher may record observations in response to the following kinds of questions:

- Does their list include actions/solutions from each category they have reviewed?;
- How many asked if all of the categories are, or if a particular category is represented in their lists?;
- How many suggested that they check their list against print material which reflects all of the categories?;
- How many pointed out that a particular category of action seems to be missing from their list?
- How many suggested adding possible actions to the list which fall under a previously unrepresented category?;
- How many remarked that a particular category (mode) of action is most appropriate for this particular issue?;
- How many remarked that a particular category (mode) of action is inappropriate for this particular issue?.

NOTE: ... The questions posed here only illustrate the kinds of indicators one might observe relative to students' knowledge and comprehension of the categories of action.

Skills

A review of the Tbilisi "Categories of Objectives" (Unesco, 1978) and "Goals for Curriculum Development" (Hungerford, Peyton, & Wilke, 1980), and other models of environmental literacy indicate that there are basically two domains of environmental skills which are commonly taught and learned:

* **Cognitive skills**: these generally reflect higher levels of Bloom's Taxonomy (i.e., analysis, synthesis, and evaluation). For the purposes of M/T/A/E in EE, two sets of cognitive skills are of particular relevance:

- skills for dealing with environmental problems and issues including: identification, investigation, analysis and evaluation skills; and
- skills for dealing with action strategies including: selecting an appropriate action strategy, and the planning, implementation, and evaluation of discrete actions.

* **Affective skills:** these generally reflect higher levels of Krathwohl's Taxonomy (1964), notably: valuing, organizing values into a system, integrating values into a world view or ethic, and acting according to these. Other frameworks which are relevant to this discussion include the values clarification process (Harmin, Kirschenbaum, & Simon, 1973), and models of moral development and reasoning (e.g., Perry, 1970; Kohlberg & Mayer, 1972; Gilligan, 1977; Kohlberg, Levine, & Hewer, 1983). For the purposes of M/T/A/E in EE, two sets of affective skills are also of particular relevance:

- skills for dealing with environmental problems and issues: weighing, choosing, affirming, and making a commitment to the resolution of particular problems and/or issues; and

- skills for dealing with action strategies including: weighing one's own values relative to proposed and actual actions, weighing one's own values in light of problem-related evidence and in light of issue-related information regarding others' values, weighing one's own values in light of potential consequences of taking action, affirming and carrying out verbal commitments to support problem/issue resolution.

Unlike cognitive skills, it is not appropriate to "test" affective skills (e.g., for individual grading or comparative purposes). At the same time, these skills are of critical importance to EE. Thus, measurement and alternative assessment strategies (M/A) which are not used for grading or comparative purposes are the most viable tools for data collection purposes. ...

****

Example: Skills For Dealing with Environmental Problems and Issues

Sample Objectives: Upon completion of instruction, students will be able to ...

- differentiate between environmental "problems" and environmental "issues;"
- identify potential causes and consequences of environmental problems;
- identify potential causes and consequences of environmental issues;
- analyze environmental issues, identifying the parties at issue ("players"), their position(s), their rationale(s) for taking that position, and the value perspective associated with those rationales;
- conduct an investigation of selected problems and associated issues using secondary sources of information; and
- clarify their own value perspective(s) on environmental issues following an analysis of both the underlying problem(s), and of the differing value perspectives apparent in that issue.

Teaching and Learning Context: In a high school environmental studies course, the first three units involved: (a) a review of ecological principles ... ; (b) a critical analysis of the roles humans play in ecological systems and in environmental problems; and (c) a brief awareness-level survey of differing types of environmental problems of global, international and national significance. ... In the fourth unit, students were exposed to the distinction between "problems" and "issues", and then to a series of both problem- and issue-analysis exercises (Ramsey, Hungerford, & Volk, 1989; Hungerford, et al., 1992). Following these, the class selected a particular problem and issue of local import, collected information on it using secondary sources (e.g., articles in the media and in periodicals), and used that information as the basis for their own problem- and issue-analysis. ... To close this unit, the teacher oversaw a combined analysis debriefing and values clarifying discussion.

Sample Test Item: Cognitive Skills

* In the space[s] below, you are asked to distinguish between environmental problems and environmental issues. To make this distinction clear, you are asked to provide and defend three examples. Please read over all three portions of this question before beginning.

a. Identify and briefly describe one environmental problem which is accompanied by an environmental issue:
____
____

Why is this both a problem and an issue? ____________________________________
____

b. Identify and briefly describe one environmental problem which is not accompanied by an environmental issue: ____________________

Why is this a problem, but not an issue? ____________________

c. Identify and briefly describe one environmental issue which does not appear to be associated with any environmental problem: ____________________

Why is this an issue, but not a problem? ____________________

Sample Assessment Item: Cognitive Skills

- Below, you will find excerpts from two articles addressing the same issue. Please read both over carefully.

ARTICLE "A"

Most Floridians who live within [a] mangrove fringe zone know the importance of these extraordinary plants.

When mangrove protection became a statewide issue during Gov. Claude Kirk'sadministration, we knew that the then-ongoing destruction of mangrove fringe and deepmangrove jungles was ecologically ruinous.

We worked with concerned citizens, the Legislature and the Cabinet, to protect mangroves. We recognized their value as a source of nutrients - natural fertilizer - and critical habitat.

Mangroves have many functions. They provide habitat for many life forms - crabs, shrimp, juvenile fish. Mangroves are resting and breeding areas for wading birds and even warblers.

When property owners who live upland of fringe mangroves - who have lovingly pruned and cared for "their" mangroves - were denied the privilege of maintaining "their" view, mangroves became their enemy."

The only way we can protect the remainingmangrove fringe and encourage the replanting of mangroves is to authorize pruning - careful pruning.

ARTICLE "B"

During the 1950s and 1960s, Florida's coastal bays and estuaries were ravaged by unregulated dredge and fill operations.

Tens of thousands of acres of wetlands and open water were converted into filled areas where housing developments, shopping centers and other developments now stand.

Because of past dredge and fill damage, the great ecological engine of the estuaries is running on only three cylinders - and it is common knowledge that both sport and commercial fishing are in a serious decline.

Other resources, such as wading bird populations - herons, egrets, ibis, and others - have also been hard-hit by the loss of estuarine habitat.

It is against this backdrop that proposals that allow the widespread "trimming" of mangroves - such as the state Department of Environmental Regulation's recent mangrove rule amendment - must be judged . . .

Now - having reaped the benefits of being able to live on waterfront property created at the cost of massive ecological damage to bays and estuaries - some homeowners demand the "right" to indiscriminately chop down new growth on public land adjacent to their property just so they can have a "view." . . .

Whole shorelines will be cut. It's a shame.

Excerpted from *Florida Today*, Sun., Oct. 25, 1992, Section A-13.

These articles portray several environmental problems. Using one sentence for each, identify 2 discrete problems presented in the articles. Then, identify a "cause" and a "consequence" of each.

Problem #1: ______________________________

____

Cause: ______________________________

Consequence: ______________________________

Problem #2: ______________________________

____

Cause: ______________________________

Consequence: ______________________________

These articles also portray an environmental issue. Please use one sentence to specify the exact issue presented in the articles.

Issue: ______________________________

____

The articles have been prepared by different writers. Using your issue analysis skills, please identify the position, rationales, and value perspectives reflected by each writer .... [NOTE: Students should be presented with an attached list of value perspectives and descriptions.]

Are any significant "players" in this issue identified in either article? If so, please list each, and identify their stated or inferred position on this issue.

Players	Stated or Inferred Position
____________	______________________________
____________	______________________________
____________	______________________________

According to information presented in the articles, has there been an apparent resolution to this issue?
Yes ____ No ____. Why did you answer as you did?

NOTE: This sample sequence of questions was adapted from "A Sample Evaluation Instrument: A Question of Progress" developed by Hungerford, Volk and Ramsey (1990, pp. 83-89).

* In cases where students are given the opportunity to choose their article or pair of articles for issue analysis, the write-up of their analysis may be used in an exhibition and/or self-selected for inclusion in their personal portfolio. ... .

Sample Assessment Approaches: Affective Skills

To find out where each student stands on a particular issue, pencil-and-paper assessment items could be added to the issue analysis (cognitive) assessment task just presented. Since it is inappropriate to evaluate (judge) or grade responses to such items, it is appropriate to clearly separate these items and clearly indicate that responses will not be evaluated/graded. Several sample formats are presented here.

- To what extent do you support the position to be taken by "Writer A"?

X	X	X	X	X
To no extent	To a slight extent	To a moderate extent	To a considerable extent	To a great extent

Why do you feel this way?

To what extent do you support the position taken by "Writer B"?

X	X	X	X	X
To no extent	To a slight extent	To a moderate extent	To a considerable extent	To a great extent

Why do you feel this way?

- A second sample, below, presents two "forced choice" formats for eliciting students' personal views (adapted from Knapp, 1973). Which of the two position do you feel more comfortable with? Place an "x" on the blank space next to the position with which you are more comfortable.

Position Taken by Writer A: _______ _______ Position Taken by Writer B

- Where do you stand on this issue? Place an "x" in the space which most nearly reflects where you stand.

Position Taken by Writer A: |_____|_____|_____|_____|_____|_____| Position Taken by Writer B:

- ... An alternative way of assessing students' views is to ask them to present their views in written and/or oral form in response to open-ended questions:

> Item: What position, if any, do you take on this issue? What are your reasons for taking this position?

****

Example: Skills for Dealing with Environmental Actions and Solutions

Sample Objectives: Upon completion of instruction, students will be able to ...

- generate a list of alternative solutions for environmental problems and issues;
- generate a list of criteria for evaluating alternative or proposed solutions for environmental problems and issues;
- identify rationales used to guide the selection of criteria for evaluating alternative solutions;
- evaluate alternative or proposed solutions against a list of criteria;
- select one or more alternative solutions for action planning in light of the results of an evaluation;
- generate an action plan for the selected alternative(s) which takes into consideration its apparent strengths and weaknesses/limitations;

- weigh their own values regarding a problem and issue for which action has been planned;
- weigh their own values toward action-taking; and
- weigh their own values regarding a planned action.

Teaching and Learning Context: These objectives were addressed in the same high school environmental studies course outlined in the previous example. The preceding units focused upon the in-depth study of various environmental problems and issues, and upon small group investigation of local manifestations of one problem/issue. The unit in which these objectives were addressed was begun when groups were about 2/3 of the way through their investigation.

In this final unit, students were provided with a series of exercises which exposed them to differing modes of action, levels of action, and criteria for evaluating actions (Hungerford, et al., 1992). Following this, each group was involved in generating a list of alternative actions, and altering this list after it was presented to the whole class. Groups were then involved in adding their own criteria to the aforementioned list, and in evaluating each alternative against those criteria. The results of this were presented to the teacher in chart form, with an accompanying narrative explanation. This evaluation served as the basis for selecting one or more alternatives, and preparing an action plan. Both mid way through action planning and at the close, the teacher oversaw discussions intended to help clarify the planning process and their own values relative to it.

Sample Test Items: Cognitive Skills

• The population size of a large, predatory species has decreased over the last 30 years due to bounty and illegal hunting, and to habitat encroachment or destruction. About ten years ago, this species was added to the U.S. Fish and Wildlife Service's list of endangered species. What kinds of action can be taken to help improve the plight of this species? Identify and briefly describe up to eight different actions which could taken here.

Action #1. ____
____
to:
Action #8. ____
____

NOTE: This species and data in this example can be tailored to fit state or regional conditions, such as those surrounding the gray wolf, red wolf, Florida panther, . . . and so on.

• In the spaces provided below, identify six distinctly different criteria which you could use to evaluate alternative or proposed action. In the space below each, . . . defend your choices.

Criteria #1: ____
____
Your Defense: ____
____
to:
Criteria #6: ____
____
Your Defense: ____
____

Sample Assessment Approach: Cognitive Skills

• In a five part paper (approx. 10 pages), each group of students will: (a) identify and describe their problem and issue; (b) list and briefly describe alternative solutions for that problem and issue; (c) list and briefly describe their criteria for evaluating those alternative solutions; (d) give the results of their evaluation of those alternatives using those criteria; and (e) present their conclusions and recommended alternative(s). This paper can be used as the basis for assessing students over several objectives. As in other cases, students may self-evaluate this work product prior to placing it in their portfolio.

Alternative Assessment Approach: Affective Skills

• The first of the sample test items for cognitive skills relating to action involved students in the identification of alternative solutions for a discrete issue (i.e., reduction in predator populations). Students' personal views on the appropriateness of these alternative solutions can be assessed through the inclusion of several separate, open-ended questions. These questions could include the following:

> How do you feel about the reduction of a species of predator like the (fill in with yours) _________ ?
>
> Do you believe that action is warranted to help maintain this species and its habitat?
> Yes ____ No ____ .
>
> If no, why not?
>
> If yes, are there any alternative actions in your list which you would strongly support? Which one(s), and why?

Affective Dispositions

Differing sources of information provide insight into the kinds of affective dispositions which may be of interest as learning outcomes in EE. First, the categories of EE agreed upon at the Tbilisi Intergovernmental Conference (Unesco, 1978, pp. 26-27) encompass a number of affective dispositions toward the environment: sensitivity, a feeling or attitude of concern, a set of values, and the motivation to actively participate (i.e., in environmental improvement). Second, a meta-analysis of studies in the area of responsible environmental behavior (Hines, Hungerford, & Tomera, 1986/87) found a number of affective variables to be strongly associated with behavior. These included: (a) locus of control (r = .365); (b) attitudes (r = .347); and (c) personal responsibility (r = .328). Hines' study reveals two important affective dispositions not apparent in the Tbilisi document. Third, other documents (e.g., Roth, 1992; Iozzi, et al., in press) suggest that these and other affective variables are relevant to EE. Some of these additions include: an appreciation of nature, stage or level of moral reasoning, and environmental ethics.

[The first task is to identify] dispositions which are likely to be influenced by a program (i.e., descriptive selection), and/or those which program staff believe should be influenced by a program (i.e., prescriptive selection). In many cases, the EE literature can provide some input regarding the relevance or utility of certain variables.

A second task is to figure out how these select affective variables can be measured or assessed. Again, the EE literature provides some guidance with respect to this task (e.g., Bennett, 1984; Iozzi, et al., in press). The examples provided in this section reflect a number of trends apparent in the EE literature.

Environmental Sensitivity

Environmental sensitivity may be defined as a personal sense of empathy toward and sense of affiliation/ affinity with the natural environment. As with other affective constructs for which there are few, if any, observable referents, environmental sensitivity is difficult to measure, and therefore to assess in a direct manner.

> As a result, other approaches were developed. One approach that has shown great promise is to measure environmental sensitivity in terms of those previous life experiences that have been found to regularly contribute to its development. Investigative research studies in the United States (Tanner, 1980; Peterson, 1982; Scholl, 1983; Peters-Grant, 1987) have identified these types of life experiences in a very consistent fashion. (Iozzi, et al., in press, p. 32)

Using the results of studies by Tanner, Peterson and Scholl, Sia (Sia, 1985; Sia, Hungerford, & Tomera, 1985/86) devised a pencil-and-paper measure of these past and current life experiences. These are reflected in the sample items below.

Sample Assessment Approaches

- Below you will find a number of questions pertaining to your childhood (and recent life) experiences. Please respond to each question by circling the number which best reflects your experience. The scale values should be interpreted as follows:

1 = Never
2 = 1 or 2 times a year
3 = About 6 times a year
4 = About 12 times a year
5 = Very often

How often did you participate in outdoor experiences such as ...

a. family vacations in outdoor/natural settings?	1	2	3	4	5
b. family outings in outdoor/natural settings?	1	2	3	4	5
c. hunting?	1	2	3	4	5
d. fishing?	1	2	3	4	5
e. hiking?	1	2	3	4	5
f. recreating in non-motorized boats (e.g., canoes, small sailboats)?	1	2	3	4	5
g. camping (e.g. in tents, shelters)?	1	2	3	4	5

- To what extent do you feel a sense of empathy toward the natural environment?

X	X	X	X	X
To no extent	To a slight extent	To a moderate extent	To a considerable extent	To a great extent

- Have you become more sensitive toward the natural environment over this past school year? Yes ____ No ____ .

If yes, to what extent have you become more sensitive?

X	X	X	X	X
To no extent	To a slight extent	To a moderate extent	To a considerable extent	To a great extent

If yes, to what extent do you think your school-related experiences have contributed to your becoming more sensitive?

X	X	X	X	X
To no extent	To a slight extent	To a moderate extent	To a considerable extent	To a great extent

- From an alternative assessment perspective, a teacher could ask each student to prepare a one page essay pertinent to their own felt level of environmental sensitivity at the beginning and at the end of a school year. As a written essay, a rubric could be developed and used to score quality of the writing (grammar), cohesiveness and expression of ideas, and degree of and influences upon personal sensitivity. This may be done in conjunction with, or apart from field experiences around the time such an essay would be written.

Attitudes

Attitudes are the most commonly measured and assessed affective disposition within EE (Iozzi, 1984), even though they tend to be shorter-lived than other dispositions (e.g., sensitivity, values, and locus of control/ efficacy are more enduring). Many dimensions of attitude have been assessed in EE. These include:

- Attitudes toward the environment:
    - towards particular species or species groupings (e.g., reptiles, large predators);
    - towards natural settings or towards nature (e.g., forests, sand dunes, coral reefs);
    - towards environmental problems or common causes of those problems (e.g., concern over pollution, technology);
    - towards social systems which interface with environmental policy (e.g., trust in government, economics); and
    - towards types of environmental action or towards environmental solutions (e.g., political action, nature preserves).

These only begin to illustrate the wide variety of dimensions of attitudes of potential interest to environmental educators and of relevance to EE.

There is an equally large number of approaches for measuring and assessing attitudes. The most common approaches for doing so are presented in the form of samples below:

- Dichotomous Value Rating Scales. Once the dimension(s) of attitude to be measured have been identified, each dimension is shaped into one or two strongly worded statements. If two statements are used per dimension (e.g., attitudes toward technology), one should be positively and one should be negatively worded. Individuals are presented with two choices such as Yes or No, Agree or Disagree.

	Yes	No
Technology will ultimately provide solutions to the environmental problems we face today.	_____	_____
Uncontrolled technology is a major cause environmental problems, and therefore, it should not be relied upon to solve those problems.	_____	_____

- Multiple Value Rating Scales. Several forms of rating scales have been commonly used to measure or assess attitudes. The most common is the Likert-type scale with values running along the strongly agree/ strongly disagree continuum (Wisconsin Center for Environmental Education, 1992a, 1992b).

If a car makes too much air pollution no one should be allowed to drive it.	SA A N D SD
It is okay if a little water gets polluted because there is plenty of water.	SA A N D SD

NOTE: These two items were taken verbatim from the Fifth Grade Survey (Wisconsin Center for Environmental Education, 1992a, Part One, Items #7 and #9). Differences of opinion exist regarding the use of neutral (N) in this scale. Some suggest that it violates the opinion/attitude continuum, while others point out that some respondents might not have on opinion/attitude and therefore deserve an opportunity to indicate this. For older students, "slightly agree" (SLA) and "slightly disagree" (SLD) values may be added to this scale to obtain a finer view of opinion/attitude.

[Another] form of rating scale involves the use of a descriptive set of scale values, such as those presented on the "To what extent" scale below. It is preferable that scale values be perceived by respondents as distinctly different points, with equivalent intervals between each.

To what extent to you agree with each of the following statements:

- If a car makes too much air pollution no should be allowed to drive it.

__X______________X______________X______________X______________X__

To no extent	To a slight extent	To a moderate extent	To a consider-able extent	To a great extent

- It is okay if a little water gets polluted because there is plenty of water.

__X______________X______________X______________X______________X__

To no extent	To a slight extent	To a moderate extent	To a consider-able extent	To a great extent

* Semantic Differential. This is a common form of attitudinal scale used to measure/assess attitudes towards broad attitudinal referents such as pollution, technology, and economics (Osgood, Tannenbaum, & Suci, 1957; Borden, 1979). Rather than select those dimensions to be rated, the broad referent is identified and rated using a series scales posed between bi-polar adjectives. The three kinds of bi-polar adjectives commonly use are: (a) good-bad (evaluative); (b) strong-weak (potency); and (c) active-passive (activity). An example from Borden (1979) and Sia, et al. (1985/86) is presented below.

POLLUTION

Weak	_____:_____:_____:_____:_____:_____:_____	Strong
Good	_____:_____:_____:_____:_____:_____:_____	Bad
Passive	_____:_____:_____:_____:_____:_____:_____	Active
Alive	_____:_____:_____:_____:_____:_____:_____	Dead
Dangerous	_____:_____:_____:_____:_____:_____:_____	Safe
Attractive	_____:_____:_____:_____:_____:_____:_____	Repulsive

NOTE: The directionality of the bi-polar adjectives is varied from one scale to the next (i.e., left hand column adjectives include weak, good, passive, and alive). This is done to prevent a quick and uniform response that might result were all of the good/strong/active adjectives presented in one column.

Values

Numerous approaches have been used to measure and assess values. A number of these approaches view values as a broad and enduring affective disposition or characteristic (e.g., Krathwohl, 1964; Rokeach, 1973). However, values do not simply come into being. Like knowledge, values are constructed from experience over time. This process involves complex interactions between intrapersonal activity (e.g., reflecting upon and becoming selective about what we prize, choose and act upon) and interpersonal activity (e.g., affirming to others and receiving feedback on what we prize, choose and act upon) (Rokeach, 1979).

* Rank Ordering of Instrumental Values. Below you will find a list of 12 characteristics which, at one time-and-place or another, humans have upheld as desirable. Take a moment to look over the list, reflecting upon how desirable each of these is to you today. When you are ready, begin ranking these in their order of importance to you. Do this by placing a "1" next to the characteristic which you feel is most important, a "2" next to the characteristic which is next-to-most important, and so on. You may also rank those which are of lesser importance by placing a "12" next to the characteristic which you feel is least important, a "11" next to the characteristic which is next-to-least important, and so on. Continue raking these characteristics until all have been assigned one number between 1 and 12.

____ a. Polite
____ b. Loyal
____ c. Thrifty
____ d. Patient
____ e. Courageous
____ f. Loving
____ g. Independent
____ h. Generous
____ i. Obedient
____ j. Honest
____ k. Assertive
____ l. Cooperative

NOTE: This exercise was adapted from the work of Rokeach (1973, 1979) and Iozzi, et al. (in press, p. 38).

• Comparative Rating of Terminal Values. Below you will find a list of 12 conditions which humans have viewed as ideals at one time-and-place or another. Take a moment to look over the list, reflecting upon how desirable each of these "ideal conditions" is to you today. When you are ready, locate the one ideal which is most important to you, and rate it on the scale. Then do the same for the ideal condition which you feel is least important, and rate it on the scale. Locate those ideal conditions which you consider to be second most and second least important, and rate each accordingly. Do the same for the third most and least important, the fourth, and so on until you have rated all of the ideal conditions contained in the list.

	Of No Importance	Of Ultimate Importance
1. A World of Beauty	|__|__|__|__|__|__|__|__|__|__|	
2. Personal Healthy	|__|__|__|__|__|__|__|__|__|__|	
3. Social Equality	|__|__|__|__|__|__|__|__|__|__|	
4. A World of Progress	|__|__|__|__|__|__|__|__|__|__|	
5. Family Security	|__|__|__|__|__|__|__|__|__|__|	
6. Ecological Stability	|__|__|__|__|__|__|__|__|__|__|	
7. Salvation	|__|__|__|__|__|__|__|__|__|__|	
8. A World at Peace	|__|__|__|__|__|__|__|__|__|__|	
9. True Friendship	|__|__|__|__|__|__|__|__|__|__|	
10. Freedom	|__|__|__|__|__|__|__|__|__|__|	
11. A Comfortable Life	|__|__|__|__|__|__|__|__|__|__|	
12. National Security	|__|__|__|__|__|__|__|__|__|__|	

NOTE: Through a series of research studies, ratings on several of the ideal conditions contained in the above list have been found to positively correlate, and some to negatively correlate with environmental behavior (Marcinkowski, 1989). In order to make the list meaningful to students in their current stage in life, it may be necessary to add and delete ideals.

Locus of Control

"Locus of control" (LOC) refers to one's perceived ability to bring about desirable outcomes in the world through one's actions. This "construct" has emerged from the work of a number of social learning theorists, notably Bandura and Rotter. The definition of this construct has evolved as the research base on it has grown.

At first, LOC was defined in terms of "internal" and "external" locus (I/E). "Internal" refers to an individual's perception that they can and will exercise some degree of control over events, while "external" refers to the perception that some kind of force/power external to themselves will control events. In due time, "external" was differentiated into "powerful others" and "chance" (I/P/C). The former refers to other powerful people serving as an external and controlling force. The latter refers to the variety of non-human external forces, actual or believed, which people perceive as affecting events in the world (e.g., luck, fate, chance).

Today, most researchers look at locus of control in varied ways, with many viewing it as equivalent to a variable which emèrged from the political sciences: "efficacy". Efficacy connotes "influence," rather than "control" per se. Studies of efficacy have explored both personal and political dimensions of the ability to influence desired change.

The sizable number of studies which have looked into environmental dimensions of LOC/efficacy (Peyton & Miller, 1980; Sia, et al., 1985/86; Hines, et al., 1986/87; Marcinkowski, 1989; Hungerford & Volk, 1990) have demonstrated its relevance for EE.

... a number of differing approaches to its measurement and assessment will be presented.

• General Internal/Powerful Others/Chance (IPC) LOC Scales. Below you will find three questions which pertain to which forces control or strongly influence the outcome of environmental problem and issue resolution efforts. Please read each over carefully. After you have done so, please circle the number on the scale which reflects your best response to each question.

A. To what extent do you believe that you can influence how environmental problems and issues are resolved?

X	X	X	X	X
To no extent	To a slight extent	To a moderate extent	To a considerable extent	To a great extent

B. To what extent do you believe that other powerful people can influence how environmental problems and issues are resolved?

X	X	X	X	X
To no extent	To a slight extent	To a moderate extent	To a considerable extent	To a great extent

C. To what extent do you believe that how environmental problems and issues are resolved is due to chance?

X	X	X	X	X
To no extent	To a slight extent	To a moderate extent	To a considerable extent	To a great extent

• General Individual and Group LOC Scales. The directions for these two questions are very similar to those for the IPC Scales (above). These particular scales were used by Sia (1985) in a study of predictors of environmental behavior.

A. To what extent you believe that you personally, working as an individual (on your own), can influence the solution of environmental issues?

X	X	X	X	X
To no extent	To a slight extent	To a moderate extent	To a considerable extent	To a great extent

B. To what extent you believe that you personally, working with others, can influence the solution of environmental issues?

X	X	X	X	X
To no extent	To a slight extent	To a moderate extent	To a considerable extent	To a great extent

* Context Specific LOC Scales. As previously noted, some theorists and researchers tend to see LOC/ efficacy as more of a context-specific sense. Here, "context" may refer to a specific issue or the level at which one can exert influence. Peyton and Miller (1980) point out that individuals with an internal LOC are better able to distinguish between those contexts in which they can and cannot exert influence. Below are several examples which mix issue- and level-specific contexts for assessment purposes.

To what extent do you believe that you can influence the resolution of solid waste issues ...

a. ... in your community?

X	X	X	X	X
To no extent	To a slight extent	To a moderate extent	To a considerable extent	To a great extent

b. ... in your county?

X	X	X	X	X
To no extent	To a slight extent	To a moderate extent	To a considerable extent	To a great extent

c. ... in your region within the state?

X	X	X	X	X
To no extent	To a slight extent	To a moderate extent	To a considerable extent	To a great extent

d. ... in your state?

X	X	X	X	X
To no extent	To a slight extent	To a moderate extent	To a considerable extent	To a great extent

* Action-Specific LOC Scales. Just as some individuals qualify the manner in which they can exert influence in terms of the issue to be resolved, the number of others involved, and the level of action, there is some evidence that individuals feel differently about the mode (kind) of action to be taken (Champeau & Peyton, 1983; Marcinkowski, 1989). This may work best for students who have learned these modes (Hungerford & Peyton, 1980; Hungerford, et al., 1990, 1992). The following scales reflect these 5 modes.

To what extent do you believe that you can influence the resolution of environmental issues in your community using ...

a. ... persuasion strategies?

X	X	X	X	X
To no extent	To a slight extent	To a moderate extent	To a considerable extent	To a great extent

b.... consumer action strategies?

X	X	X	X	X
To no extent	To a slight extent	To a moderate extent	To a considerable extent	To a great extent

c.... ecological action/resource management (ecomanagement) strategies?

X	X	X	X	X
To no extent	To a slight extent	To a moderate extent	To a considerable extent	To a great extent

d.... political action strategies?

X	X	X	X	X
To no extent	To a slight extent	To a moderate extent	To a considerable extent	To a great extent

e.... legal action strategies?

X	X	X	X	X
To no extent	To a slight extent	To a moderate extent	To a considerable extent	To a great extent

NOTE: The stem to this questions can be made as general or specific as fits the teaching/learning situation in the classroom. For example, it could read: "To what extent do you believe that you, working as an individual, can influence the resolution of solid waste issues in your community using ..... ."

Personal Responsibility

To date, less attention has been paid to the measurement and assessment of "personal responsibility" than to other affective dispositions presented in this section. Some research does exist to suggest the importance of this variable, though even Hines' (Hines, et al., 1986/87) results are based on a small number of studies (n=6). A cursory review of those studies indicates that there are multiple dimensions to this variable, much as there are for attitudes and locus of control. It appears that the assumption of personal responsibility encompasses "the recognition of, the internalizing of responsibility for, and the willingness to address" environmental problems and issues (Iozzi, et al., in press, p. 58).

- Due to current limitations in understanding this variable, it is difficult to draft pencil-and-paper items. Some do exist, and rely on straightforward wording.

23. Environmental problems will only be solved when people like me change the way we live. (WCEE, et al., 1992a, p. 5) and

33. I feel that it is my responsibility to help solve environmental problems. (WCEE, et al., 1992b, p. 5)

- Since the ability to measure this variable is limited, other assessment approaches should be considered.

It is necessary to rely upon more qualitative approaches emphasizing direct observation (i.e., of overt and verbal behavior) such as the collection of anecdotal reports, and the collection of writing samples. (Iozzi, et al., in press, p. 58). ...

Responsible Environmental Behavior (REB)

Just as affective dispositions are never "tested", students' environmental behavior is never "tested" (i.e., what students and others report doing/not doing should not be used for grading purposes). Yet, within the context of our government and society, acting in a responsible fashion is perceived as both a right and a responsibility. How are these two ideas reconciled? Students are permitted to act, and may even be supported in doing so, though they should never be required to act (i.e., in either the general sense or in a specific situation) (Hungerford, et al., 1992, p. 146). On the other hand, a substantial number of EE sources support the idea that students should be provided with opportunities to develop an understanding of, and the ability to apply problem-solving strategies and skills (e.g., Harvey, 1977; Unesco, 1978; Hungerford, Peyton, & Wilke, 1980; Hart, 1981; Hungerford & Volk, 1990).

Due to the widespread recognition of the importance of environmental behavior in EE, and more generally, within our society, a substantial number of approaches have been developed for measuring and assessing student involvement in environmental action and problem-solving. Examples of a number of these [follow].

* In a study comparing differing approaches to EE, Ramsey (Ramsey, 1979) began his assessment by asking students to: "Please list as many different kinds of environmental actions as you can" (p. 117). Students were provided with a full page on which to list their responses. ...

* A second approach to measuring environmental behavior is to present students with specified behaviors, and ask them how often they engage in each: "Never," "Almost Never," "Sometimes," "Almost always," or "Always".

- I try to save water.
- I try to eat at places that use little packaging
- I ask people to recycle
- I avoid purchasing products that are overpackaged.
- I write or call politicians to express my views about environmental issues.

This approach has been used in Wisconsin's statewide environmental surveys (WCEE, et al., 1992a, p. 5; 1992b, pp. 6-7).

* A different approach to measuring how often students engage in differing kinds of behavior was used in a series of graduate studies completed at Southern Illinois University (Culen, Hungerford, Tomera, Sivek, Harrington, & Squillo, 1986). This measure involved presenting students with the five categories or modes of action and asking them to record the number of individual and number of group actions they remembered taking over the past year on a self-selected issue. It follows:

Action Categories

Ind. Actions?	Group Actions?	
_____	_____	1. Persuasion: An effort to motivate others to take positive environmental action, e.g., argumentation, debate, speech making, letter writing, etc.
_____	_____	2. Consumer Action: Involves buying something that agrees with, or avoiding (boycotting) something that disagrees with an environmental idea.
_____	_____	3. Ecomanagement: Any physical action taken which was intended to directly benefit the natural world, such as soil erosion controls, bird boxes, litter pick-up, etc.
_____	_____	4. Political Action: An effort to bring pressure on political or governmental bodies and/or individuals in order to persuade them

to take positive environmental action.

____ ____ 5. Legal Action: An action taken aimed at the establishment, enforcement, or alteration of environmentally-related laws, such as reporting violations, and lawsuits.

• A third approach to the measurement of behavior involves the identification of possible actions which fall into each of the five categories and collecting data on how frequently each person has engaged in each (e.g., Champeau & Peyton, 1983; Sia, et al., 1985/86; Marcinkowski, 1989). The sample below and on the next page was adapted from Iozzi, et al. (in press, p. 51), and reflects the category, consumer action.

Look over the list of actions presented below. Think over the approximate number of times in which you engaged in each of these last year. Then, circle the number which reflects your best recollection or estimate.

Action/Activity	Number of Times
1. Purchased non-lead gasoline.	0 1 2 3 4 5+
2. Purchased low/no phosphate soaps or detergents.	0 1 2 3 4 5+
3. Purchased beverages in returnable containers.	0 1 2 3 4 5+
4. Purchased beverages in recyclable containers.	0 1 2 3 4 5+
5. Purchased other goods in recyclable containers.	0 1 2 3 4 5+
6. Purposely purchased brands with less or no packaging.	0 1 2 3 4 5+
7. Purposely purchased only those types of plastic which you can recycle.	0 1 2 3 4 5+
8. Purposely avoided the purchase of styrofoam (i.e., purchased paper products).	0 1 2 3 4 5+
9. Purposely avoided the purchase of aerosol containers (e.g., purchased pump sprays).	0 1 2 3 4 5+
10. Purposely avoided the purchase of seafood products taken from at-risk marine populations (e.g., tuna, whales, sea turtles).	0 1 2 3 4 5+
11. Purposely purchased locally grown food products.	0 1 2 3 4 5+
12. Purposely purchased organically grown food products.	0 1 2 3 4 5+
13. Grown food products for household consumption.	0 1 2 3 4 5+
14. Participated in a boycott of an environmentally unsafe product.	0 1 2 3 4 5+
15. Requested store personnel to carry products with a low environmental impact.	0 1 2 3 4 5+
16. Another consumer action you took: ____________________	0 1 2 3 4 5+

* If students have engaged in some kind of action project following their analysis and/or investigation of the associated issue(s) (e.g., Bull, Cromwell, Cwikel, Di Chiro, Guarino, Rathje, Stapp, Wals, & Youngquist, 1988; Hungerford, Volk, & Ramsey, 1990; Hungerford, et al., 1992), other approaches can be used to assess students' environmental behavior. These include:

- Reviewing students' written reports of the development, implementation, and evaluation of their actions. These written reports may include concept maps of the problem/issues/actions addressed;
- Asking each student or each group to deliver an oral report of the development, implementation, and evaluation of their actions to the teacher, the class, other classes (e.g., assemblies), and/or to other groups (e.g., a number of student groups have reported to city councils). With students' permission, such presentations could be taped;
- Placing written and/or taped oral reports on exhibit for other students, teachers, and selected community members to review; and
- Students' self-evaluating written and/or taped oral reports for inclusion in a personal portfolio.

Section V: Closing

The field of EE has been experiencing a new wave of growth. With the advent of the National Environmental Education Act, there now exists an Office of Environmental Education within EPA, and a private National Environmental Education and Training Foundation (NEETF). The National Council of State Governments has recently approved "Model State Environmental Education Legislation". An increasing number of states have passed EE legislation, and are earnestly involved in seeing it implemented. Nationally available curricula are in development (e.g., Project WET), have been expanded (e.g., Project WILD now includes Aquatic WILD), have been recently revised (e.g., Project Learning Tree), or are now available through wider networks (e.g., Investigating and Evaluating Environmental Issues and Actions is on the U.S. Department of Education's "National Diffusion Network"). At the district, school and classroom levels of education, an increasing number of teachers are working with topics, problems, issues and solutions which fall under the heading of EE, and are using an ever growing body of resource print and AV resource materials.

New waves of growth such as this both require data to guide decision making, and often create new M/T/A/E [measurement, testing, assessment, and evaluation] needs. Large and small grants awarded by EPA's Office of Environmental Education or by NEETF must be evaluated. New state programs must be evaluated, and new statewide T/A/E requirements must be fulfilled. New and revised curricula must be field tested. There should be both support for and monitoring of teachers' implementation of new curricula, with attention to both the school program and the curricular program. With the growing number of print and audio-visual materials available to teachers, there is also a rapidly growing need to assess what "materials are good for" so that district personnel can better select materials and integrate them into the district curriculum. Unfortunately, the evolution of M/T/A/E in the field has not kept pace with these other developments and needs. What is represented [here] may help some professionals in the field address these current and growing needs. Nonetheless, it is recognized that a written document, by itself, is likely to have a limited impact.

Unfortunately, too few teachers have been provided with opportunities to (further) develop their skills in EE, or in M/T/A/E. The number of graduate programs in the field has increased over the past few years, though evidence as to their impacts seem scant and controversial (e.g., Champeau, Gross, & Wilke, 1980; Wilson, 1988). While each graduate program evaluates and often follows up on its graduates, there is little in the way of an organized and published body of evidence regarding the adequacy of the research and evaluation training components of these graduate programs. And, as has been true for decades, the legacy of not providing teachers with a strong education in M/T/A/E until graduate school (if at all) leaves many teachers disempowered. The need for professional development - whether by pre-service, in-service, graduate, or other offerings and opportunities - can be better met by universities across the country which serve the field.

Nonetheless, the onus of responsibility for these needs cannot be directed at only one sector, for many sectors play important roles in shaping curricular, instructional, and M/T/A/E practices in EE (e.g., K-12 teachers, district administrators and specialists, state education agency personnel, nonformal educators, etc.). A forum must be established in which professionals from each sector can come together to share their needs, concerns and strategies for M/T/A/E of EE. It is hoped that this [reading] serves as a stimulus for professionals to reflect upon, and ultimately to take action - individually and collectively - in response to two broad questions: "What is EE about?" and "How can we best approach the M/T/A/E of what we are doing in EE?" The responses we give to these two questions will determine the quality and, in some cases, even the viability of EE programs across the country. Our current and future students, future generations, and hopefully, the environment stand to gain from the deliberate and collective efforts we initiate today.

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Outcome Research in Environmental Education: A Critical Review

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In this landmark study, the authors included an analysis of the 34 environmental education studies published since 1974 that attempted to demonstrate changes in environmentally relevant knowledge, attitudes, or behaviors. The writers divided the studies into two major categories -- in-class and out-of-class programs -- and critiqued the studies' findings and methodologies. Although many of the investigations contained methodological difficulties, some of the findings indicated that future research could refine environmental education strategies and curricula.

Interestingly, although some advances have been made to date in the research arena in environmental education, we find that the field has remained basically unchanged since these writers challenged researchers to improve their techniques. This, then, makes this article even more important than one might imagine at first glance.

Over the past 2 decades, interest in environmental education has produced a wealth of literature, although relatively little of the literature has provided empirical evidence of the outcomes of environmental education. Some writers believe that focusing on such outcomes may be inappropriate (e.g., Colwell, 1976; Robottom, 1989); they believe that the process occurring during environmental education is an adequate justification for the activity. However, many others (e.g., Hines, Hungerford, & Tomera, 1986-87; Hungerford & Volk, 1990; Roth, 1970) maintain that the primary goal of environmental education should be to encourage people to engage in more pro- environmental behaviors. For those who accept the latter view, the assessment of outcomes is critical for the identification and refinement of effective techniques. The purpose of our review is to help researchers and educators select and further develop the most promising approaches toward environmental education.

Two earlier reviews provided some insight into the status of our knowledge regarding environmental education outcomes. Lewis (1981-82) reviewed studies of classroom methodologies and instructional strategies, but he excluded those in which attitude was the only dependent variable, as well as articles that focused on models, philosophies, and environmental problems. As a result, he reviewed only seven studies. Lewis concluded that most of the reports lacked sufficient methodological detail, that some assessment instruments were of questionable validity, and that there was "a distinct lack of well controlled studies" (p. 15). He suggested that future researchers report on methodology in greater detail, include a control group, and describe the evaluation instrument in considerable detail, particularly when the instrument has been developed by the researcher.

The purpose of our review is to help researchers and educators select and further develop the most promising approaches toward environmental education.

More recently, Hines et al. (1986-87) reported results of a meta-analysis of research on responsible environmental behavior. Because of the small number of studies they found in this category, they were unable to meta-analyze experimental (intervention) research; instead they focused on the identification of variables correlated with environmental behavior. Variables that correlated with some indicator of responsible environmental behavior included verbal commitment, locus of control, attitude, personal responsibility, and knowledge. Corrected correlation coefficients ranged from .491 for verbal commitment to .299 for knowledge.

This review provides a more comprehensive survey of the experimental literature in environmental education than that presented by either Hines et al. (1986-87) or Lewis (1981-82) and focuses more on the effectiveness of various environmental education interventions. We searched several prominent journals, including the *Journal of Environmental Education*, *Environment and Behavior*, *Science Education*, and *Journal of Research in Science Teaching*, and two computerized databases, PsycLit and ERIC, using descriptors such as environment, environmental education, environment and knowledge, environment and behavior, and environment and attitude. We also used Iozzi's (1981) review of research in environmental education from 1971 through 1980. In all, we found 34 studies meeting our criteria.

We reviewed published experiments evaluating the effects of a manipulated independent variable intended primarily to alter environmentally relevant knowledge, attitudes, or behaviors.

We reviewed published experiments evaluating the effects of a manipulated independent variable intended primarily to alter environmentally relevant knowledge, attitudes, or behaviors. We did not discuss either correlational studies (e.g., predictors of environmental behaviors) or studies measuring only existing attitudes or knowledge levels concerning environmentally relevant topics. We also excluded studies using environmental education as a vehicle to pursue other ends, such as helping the developmentally delayed or learning disabled, assisting with the academic adjustment of special and minority student populations, or evaluating field trips as a general educational tool. We did not include behavior modification studies that targeted specific behaviors or that did not focus on environmental education because such studies have been the subject of other reviews (e.g., Dwyer, Leeming, Cobern, Porter, & Jackson, 1992; Geller, Winett, & Everett, 1982). Our review focused on school children as the primary targets of the intervention, although we included a few studies with adults. We organized the review around two categories of research: studies focusing on in-class methodologies and studies focusing primarily on methodologies outside of the normal classroom setting.

Classroom Interventions

We found 17 papers evaluating interventions occurring primarily within the context of a normal classroom setting. We summarize relevant characteristics of these studies in Table 1. Studies in this section are organized by the age of the subjects, with those using the youngest presented first.

Bryant and Hungerford (1979) evaluated the effects on kindergarten children of instruction on the environment and environmental problems. Bryant taught two classes: both simultaneously received 1 week of instruction on an introductory module that familiarized students with the term *environment* and with the environment's living and nonliving parts. One class subsequently received a 3-week environmental unit consisting of activity-oriented material on pollution and solid waste, whereas the other class received a standard curriculum with no mention of environmental issues. The researchers then reversed the conditions and assessed the instruction by asking four questions of each child individually, in private (apparently by the teacher), both before and after the environmental unit. The questions involved both knowledge of the material and opinions about environmental problems. Results showed a significant change in each class following presentation of the environmental material, and the authors concluded that kindergarten children are capable of forming concepts concerning environmental issues and citizenship responsibilities. Two [other] studies used third-grade students. Fennessey, Livingston, Edwards, Kidder, and Nafziger (1974) compared traditional environmental education with an environmental simulation exercise and an environmental simulation game. Third-, fourth-, and eighth-grade students received the instructional units in ten 45-minute classes over a 2-week period. Using their own questionnaire, the experimenters failed to find significant differences in knowledge or attitudes among any of the three treatment groups. However, because there were no untreated control classes, results were inconclusive as to whether the different approaches were all either equally effective or whether none of them had any effect. Because the experimenters did not administer follow-up tests, they were also unable to provide information about possible differences in long-term effectiveness of the techniques.

Jaus (1984) studied the short-term and long-term impact of only 2 hours of environment education. Two intact third-grade classes were pretested on a 10-item, experimenter-designed, Likert-type questionnaire to assess environmental attitudes. The classes did not differ significantly on the pretest, and mean scores were almost identical. A teacher then presented 2 hours of environmental lecture material to one of the classes over a period of 5 consecutive days. Topics included recycling, pollution, and conservation. The control class received a normal curriculum that did not include environmental information, although the author did not specifically mention the teacher of, or the material covered by, the control class. Three school days after completion of the instruction, the researcher readministered the same questionnaire to both classes. The experimental class showed scores almost 30% higher than on the pretest, whereas the control class showed an increase of less than 2%. Experimental scores differed significantly from both their own pretest scores and the posttest scores of the control subjects. The most impressive finding, however, was that when the children were tested with the same questionnaire as fifth graders, the experimental subjects continued to show significantly more positive attitudes toward the environment than the control subjects did. The author concluded that, to be maximally effective, environmental education programs should emphasize the affective as well as the cognitive domain. It is not clear, however, as to how the 2-hour presentation used in the study accomplished that goal.

Three papers described work with fifth graders. Asch and Shore (1975), who compared an instruction group with an untreated control group, found strong effects on behavior change. These experimenters used the directly observed behaviors of 24 fifth-grade boys during a 4-day visit to a nature center as their dependent variable. One author had taught environmental education to half of the boys over the two previous years. The other half were control subjects randomly selected from a class visiting the same nature center. Trained raters unfamiliar with the nature of the study or the different backgrounds of the subjects noted the occurrence of specified conservational and destructive behaviors. Behaviors were recorded during four tasks (building a small shelter, making changes to a creek, fishing in a small pond, and making a vegetable garden). Results showed that the experimental group exhibited significantly more conservational than destructive behavior during each task. In contrast, the control group exhibited more destructive than conservational behaviors. The difference between experimental and control subjects was significant on each of the four tasks. Although the authors did not provide long-term follow-up data, their use of direct observations of relevant behaviors makes this an important study, and we find it regrettable that few other researchers have continued this approach.

In another experiment with fifth graders, Jaus (1982) gave one class 40 minutes of environmental education on each of 15 consecutive school days. Each lesson involved typical lecture, discussion, laboratory activities, and homework. A control class of fifth graders in another school did not receive any environmental education. Both classes were then administered an experimenter-developed instrument that measured attitudes toward the environment. The 20-item instrument asked subjects to rate on a 5-point Likert-type scale whether other fifth graders should know the concept or idea expressed in each item. Attitudes expressed by the experimental subjects were approximately 22% more positive than those of the control subjects -- a difference that was highly significant. In an attempt to show that the effect was due to the educational material, Jaus gave the control class the same instruction. When retested on the attitude scale, these subjects showed a significant increase to a score almost identical to that of the experimental group. It should be noted, however, that some of the increase in their scores could have been due to repeated administrations of the scale.

Aird and Tomera (1977) studied the effects of water-conservation instruction on the values held by sixth-grade students. The single experimental class received both direct instruction and assigned activities over a 2-week period. Activities included observation and measurement of the students' own water use, oral reports on water use, and discussion of methods for personal water conservation. The single control class received no instruction related to water conservation. Both classes were tested on a 3-item, experimenter-developed "opinionnaire" before and after the experimental class received the special material. This instrument asked subjects to list threats to water supplies, what should be done to conserve water, and actions the individuals actually would take to conserve water. Results showed that the experimental subjects differed significantly from both their own pretest scores and the posttest scores of the control subjects.

In an experiment directly comparing different grade levels, Armstrong and Impara (1991) studied the effects of an environmental education supplement on the knowledge and attitudes of fifth- and seventh-grade classes. Although the program was not found to have significant effects upon knowledge or attitude at either grade level, this experimental method is an excellent model for future environmental education research. The re-

TABLE 1. Summary of Classroom Interventions

Reference	Subject grade	Independent variable	Duration of I.V.	Dependent variable	Effect	Follow Up
Aird & Tomera, 1977	6	Instruction & activities	2 weeks	Attitude, knowledge	+	0
Armstrong & Impara, 1991	5, 7	Instruction	4-8 weeks	Attitude, knowledge	--	0
Asch & Shore, 1975	5	Instruction	2 years	Behavior	+	0
Birch & Schwab, 1983	7	Instruction	?	Attitude, knowledge	+	0
Bryant & Hungerford, 1979	K	Instruction	1 month	Knowledge	+	0
Carpenter, 1981	College	Course	Semester ?	Attitude	?	0
Fennessey et al., 1974	3, 4, & 8	Game vs. simulation vs. traditional	2 weeks	Attitude, knowledge	--	0
Hepburn et al., 1978	9, 10	Curriculum	15 vs. 30 days	Attitude	Mixed	0
Hounshell & Liggett, 1976	6	Activities	7 weeks	Attitude, knowledge	Mixed	0
Howell & Wambrod, 1974	11, 12	Manual	6 weeks	Attitude	--	0
Jaus, 1978	Teachers	Instruction	10 days	Attitude	+	0
Jaus, 1982	5	Instruction	10 hours	Attitude	+	0
Jaus, 1984	3	Instruction	2 hours	Attitude	+	2 years
Ramsey et al., 1981	8	Instruction (action vs. issue)	7 months	Knowledge, reported behavior	+	2 months
Ramsey & Hungerford, 1989	7	Instruction (action + issue)	18 weeks	Knowledge, reported behavior	+	0
Simmons et al., 1977	High school	Values clarification	3 weeks	Attitude, knowledge	?	1 year
Wilson & Tomera, 1980	10	Case study and simulation	3 days	Attitude	Mixed	0

searchers clearly described relevant details, carefully constructed measurement instruments adapted from those used by other researchers, sampled classes from a relatively large population over two states, and used the classes as the unit of analysis in the statistical tests.

Two other studies also used seventh graders. Birch and Schwaab (1983) assigned seventh-grade life sciences classes with a total of 843 children to experimental and control conditions. Experimental subjects received an instructional unit of unspecified length dealing with water conservation.

This unit included a 30-page booklet, slide programs, a film, and demonstration models. Additionally, their teachers had all attended a water-conservation workshop. Controls received no such material, and their teachers had not attended the workshop. A questionnaire constructed by the authors showed highly significant differences between experimental and control groups on both knowledge of and attitudes toward water conservation. Further, there was a significant correlation between knowledge and attitude. The authors did not administer follow-up tests.

Ramsey and Hungerford (1989) investigated the effects of a curriculum package emphasizing both issue investigation and action training (IIAT) on environmental behavior in seventh-grade students. Four classes received IIAT instruction for 18 weeks, whereas a control group of four other classes received the usual science instruction over the same period. A pretest showed no significant differences between groups on reported environmental behavior. A posttest administered following the treatment period found significant differences on reported environmental behavior as well as self-perceived knowledge of and skill in the use of environmental action skills, individual and group locus of control, and possible solutions to environmental problems. The groups did not differ on a measure of environmental sensitivity. Unfortunately, the researchers did not collect follow-up data.

In an earlier study using eighth-grade students, Ramsey, Hungerford, and Tomera (1981) compared classroom instruction designed to create environmental awareness with instruction in specific environmental actions. Three eighth-grade classes were used, with the third class receiving a standard science curriculum to provide an untreated control group. The two experimental classes were from a public junior high school, and the control class was from a neighboring parochial school. The dependent variables were students' knowledge of environmental problem-solving skills and students' self-reported independent environmental behaviors (i.e., environmental actions that were taken by the student over and above school and classroom activities). Pretesting showed no significant differences among the groups on any of the measures. Following 7 months of instruction, posttest questionnaire data showed that the group trained on environmental actions exhibited a greater knowledge of environmental actions than did the other two groups, which did not differ significantly. In addition, the action-training group reported significantly more environmental action behaviors than the awareness groups did; the awareness group did not differ from the control group.

Two months after instruction ended, Ramsey et al. (1981) also administered questionnaires to parents concerning their children's environmental awareness and actions, both during instruction and during the subsequent 2 months. Parental response data were very similar to those of the children and showed that children given action training continued to show more environmental behaviors than did either of the other two groups. Hungerford and Volk (1990) described additional follow-up work 3 years later. They reported that trained interviewers unaware of students' previous conditions met with the former subjects in their secondary schools. They found that those students who had been in the experimental condition were still "involved in more environmentally appropriate behaviors than their counterparts. However, it was clear that the original behavior observed in the eighth grade had eroded over time" (p. 14). Presumably, the experimental condition referred to is the action-training group. Although statistical analyses were not reported for either the 2-month or the 3-year data, few other experimenters have made any attempt to evaluate long-term effects. Thus, we found these results most encouraging.

Four studies used students in Grades 9 through 12. Howell and Wambrod (1974) found no effect on environmental attitudes of a student manual on environmental protection. The manual was used as part of an environmental education program for 11th and 12th graders in 16 science classes and in 20 vocational agriculture classes. The dependent measure was an author-developed survey for measuring attitudes toward protection of the environment. A pretest-posttest design was used. Half the students in the 6-week environmental education program used the manual (which emphasized hands-on activities) in conjunction with the course; the other half did not. Results indicated that use of the manual produced no significant change in environmental attitudes for either the science students or the vocational agricultural students.

Simmons, Neakrase, and Bemont (1977) studied teacher-developed lessons for clarifying values in relation to the development of knowledge of and attitudes toward ecology. Fourteen high school students were pretested on ecology knowledge and attitudes and then given a 3-week course on general ecological principles, air pollution, and water pollution. At the same time, they were assigned various values-clarification activities such as values sheets and action projects. A subsequent posttest showed a significant increase in achievement and attitude scores. A 1-year follow-up showed only slight decreases in achievement and no decrease in the attitude scores. However, as pointed out by numerous writers (e.g., Campbell & Stanley, 1966), their one-group, before-after design contained too many threats to internal validity to allow conclusions about the effects of the lessons. Still, we commend these authors for obtaining follow-up data.

Hepburn, Shrum, and Simpson (1978) studied amount of exposure to environmental studies in 9th- and 10th-grade students. Environmental modules were incorporated into social studies classes, science classes, or both. Each module was designed for 15 days of instruction and included case studies, readings, role play, field trips, discussion, and simulation. Ninth- and 10th-grade classes were assigned to one of the following conditions: science module only (15 days), social studies module only (15 days), both the social studies and science modules (30 days), or no formal environmental studies. A Likert-type scale designed to measure students' attitudes toward population growth and pollution was administered before and after treatment. Results indicated that the 30 days of instruction in both social studies and science had the greatest overall effect at both grade levels. When considering attitudes toward population growth, the group receiving the combined modules and the group receiving the science module showed the greatest shift in attitude. There were no significant differences when considering only attitudes toward pollution, possibly because these attitudes were already strong.

Wilson and Tomera (1980) studied the effects of simulations combined with case studies on attitudes toward environmental issues in two classes of 10th-grade students. For the experimental class, a 3-day period of case study and simulation exercises was appended to a section of the normal curriculum in the general biology course. The control class received only the standard curriculum. Experimental and control classes were then reversed for a second segment of the course. Before-and-after measures of attitudes toward the first issue showed a significant effect of the treatment, but the effect failed to reach significance with the second issue. The authors suggested that because the control subjects had received the treatment during an earlier part of the course, their attitudes toward environmental issues had already been raised, creating a ceiling effect. In both cases, however, the experimental class received an additional 3 days (30-40%) on the target subject. Thus, differences between experimental and control classes could have resulted partially or completely from this extra instruction.

Only one study has tested the effects of classroom instruction with college students. Carpenter (1981) used an author-developed scale to measure commitment to environmental issues at the beginning and end of a college environmental earth-science course. Results showed a significant increase in commitment level on 10 of the 14 issues considered. Use of a one-group before-after design, however, casts considerable doubt upon the conclusion that the effect was due to the course material. Finally, we chose two papers that focused on environmental education material presented to teachers. The first studied effects on the students of the treated teachers, whereas the second measured changes only in the teachers. Hounshell and Liggett (1976) attempted to evaluate the effects of a teacher-training program developed by an environmental education center. The center assisted randomly selected sixth-grade teachers in preparing a set of activities concerned with developing environmental awareness and learning exercises. These activities were then carried out by the experimental teachers during a 7-week intervention period. Untreated control children were from sixth-grade classes from neighboring counties. Data were collected from approximately 1,000 children who were tested on an environmental questionnaire measuring both knowledge and attitude. Experimental children were found to differ significantly from controls on the attitude questions, but not on the knowledge questions. Of course, there is no possibility of evaluating the effects of the teacher-training program because there was no control group receiving an equal-length environmental curriculum presented by untrained teachers. Further, it is hard to understand why knowledge was not increased by 7 weeks of instruction.

Jaus (1978) showed positive effects of environmental education instruction on teachers' attitudes toward presenting environmental education in their classrooms. Fifty-one elementary and middle school teachers were randomly assigned to one of two graduate-level courses in science methods. Both groups received the same instruction over the first 10 days. Over the next 10 days, however, the experimental group received instruction in environmental education and participated in several relevant activities such as designing a grade-level curriculum and conducting an experiment. The control group received instruction in teaching science to elementary and middle school children and participated in similar activities not restricted to environmental topics.

Following the treatment, both groups were given an instrument to measure attitudes toward teaching environmental education. Although both groups favored teaching environmental education, the experimental group had significantly more positive attitudes than the control group did. Again, follow-up measures were not taken, so there is no evidence of any effect upon the subsequent behavior of the teachers when they returned to their teaching duties.

In summary, most of the studies reviewed above evaluated a special environmental education curriculum package, but several others used a distinctive instruction technique such as simulation or a case study. Investigators used a wide range of subjects, but only the Bryant and Hungerford (1979) study with kindergarten children involved subjects below the third grade. Few studies made explicit comparisons of different age groups. Although the majority of the studies reported positive effects of the intervention, only two provided any follow-up information beyond assessment immediately after the intervention. Further, most of the papers reported a very simple experiment showing only that the intervention influenced attitudes or knowledge relative to an untreated control group rather than comparisons of different types of interventions.

Out-of-Class Interventions

In this section, we review 17 papers that evaluated interventions emphasizing activities primarily outside of a normal classroom setting (see Table 2 for relevant characteristics of these studies). The studies in this section are presented in ascending order of the age of the subjects. Shepard and Speelman (1985-86) studied the impact of participation in a specific outdoor education program on environmental attitudes of 613 children, aged 9 to 14, attending 3- to 5-day 4-H camps. A Solomon four-group design was used, with half of the subjects receiving a pretest and all subjects receiving a posttest on an attitude scale developed by the authors. The experimental group consisted of 405 campers selecting outdoor education as one of their four camp programs. The remaining 208 campers who did not select this activity served as controls. Presentation of the data and statistical analysis are limited, but the authors refer to a lack of significance between the experimental and control groups (p. 22). However, they suggest differences between first-time and repeat campers, and between rural and urban campers. Still, the potential for bias, because of self-selection of the program, makes it impossible to draw any conclusions from this study.

Three studies used fifth-grade children, including that of Howie (1974), who directly compared indoor and outdoor environmental education activities. In a complete factorial experiment, 438 children were randomly assigned by classroom to one of four conditions: indoor treatment, outdoor treatment, both, or neither. The outdoor treatment consisted of a series of activities over 2 days at a nature center, and the indoor treatment consisted of 10 hours of lecture and discussion of environmental topics. Following treatment, subjects were administered an author-developed scale to measure knowledge of environmental concepts and applications. Results showed that all three treatment groups exceeded the controls on both knowledge and application scores. There was little difference among the treatment groups regarding applications, but the two groups receiving classroom material were both superior to the outdoor-only group on the knowledge portion of the scale. The author concluded that even though there are many benefits of outdoor experiences, classroom instruction is necessary for students to gain the full benefit of such experience. Unfortunately, Howie did not administer a follow-up test to determine whether the observed effects persisted beyond the time of the particular experiences. Measurement of attitudes toward, in addition to knowledge of, the environment might also have demonstrated some of the positive effects the author suggested for the outdoor experiences.

Using five randomly selected classes of fifth-graders, Wendling and Wuensch (1985) compared the effects of traditional lectures, hands-on classroom activities, and a field trip on environmental knowledge and attitudes. Classes were assigned to one of the following conditions: lecture only, hands-on classroom activities only, lectures plus field trip, classroom activities plus field trip, or classroom activities plus field trip plus post-trip summary. The authors provided little information about the nature of either the hands-on activities or the field trip, although they did state that activities began 2 weeks before the field trip. Regular classroom teachers administered pretests and posttests of an experimenter-constructed knowledge and attitude scale. Analysis of knowledge data showed significant differences among groups in pretest-posttest difference scores. Additional analyses showed that students who participated in the hands-on classroom activities learned more than those who did not, and students who participated in the field trip learned more than those who did not. Yet we find it difficult to understand why the control class showed a decline in knowledge score from an initial mean of 9.12 to a mean of 7.80

TABLE 2. Summary of Out-of-Class Interventions

	Subject grade	Independent variable	Duration of I.V.	Dependent variable	Effect	Follow up
Brogden et al., 1977	College	Field trip	?	Attitude	--	0
Crater & Mears, 1981	8	Activities	?	Attitude, knowledge	?	0
Dunlop, 1979	Teachers	Workshop	1 hour	Attitude	?	0
Fortner, 1985	9	TV vs. lecture	30 min. vs. ?	Attitude, knowledge	Mixed	2 weeks
Fortner & Lyon, 1985	Adult	TV program	30 min.	Attitude, knowledge	+	2 weeks
Horsley, 1977	College	Act as agent	12 days	Attitude, behavior	Mixed	7 weeks
Howie, 1974	5	Indoor vs. outdoor	10 hours	Knowledge	+	0
Huber et al., 1981	H.S.	Camp activities	3 weeks	Attitude	?/--	0
Jordan et al., 1986	H.S.	Residential workshop	6 days	Knowledge reported behavior	+	2 months
Kostka, 1976	6	Activities	2 weeks	Attitude, reported behavior	--	0
Lisowski & Disinger, 1991	H.S.	Residential marine-science programs	7 days	Knowledge	?	4 weeks
Quinn, 1976	10	Value sheets	10 weeks	Attitude	--	0
Ryan, 1991	5	Visit to conservation area	1 day	Attitude	?	0
Shepard & Speelman, 1985	9-14 yrs.	Camp program	3-5 days	Attitude	--	0
Simmons, 1984	Adult	Workshop	1 day	Atittude, knowledge	--	3 months
Wendling & Wuensch, 1985	5	Activities, field trip	2 weeks	Attitude, knowledge	Mixed	0
Wendling et al., 1989	5	Activities, field trip	2 weeks	Attitude	+	0

following the 2 weeks of traditional lectures. On the attitude items, there was an overall improvement from pretest to posttest, but the groups did not differ significantly.

In a later paper, Wendling, Wuensch, and Christiano (1989) reanalyzed the attitude data from the Wendling and Wuensch (1985) study with the addition of subjects' race as a variable. They found several interactions of race with the treatment condition. Pretest scores showed Whites to have more positive attitudes toward the environment than non-Whites, and hands-on activities produced a more positive attitudinal change in non-Whites than in Whites. Combining hands-on activities with traditional classroom lecture was found to eliminate pretreatment racial differences in attitude scores.

Ryan (1991) compared attitudes of fifth-grade students who had visited a conservation area with others who had not. Procedural information in the report is limited, and it is not clear when the instrument was administered, although the authors implied that it was a full year after the visit. Selection bias is a possibility because there is no information as to why some children made the trip and others did not. The author compared differential responses to individual items but did not describe the complete instrument and may have ignored some items. However, few of the items showed a difference in attitude between children who visited the conservation area and those who did not. Unfortunately, there are no pretest data and the groups were not randomly constituted, so any differences that were observed could have existed before the visit. Thus, we cannot draw any conclusions from this study.

In a study similar to that of Wendling and Wuensch (1985), but using sixth-grade children, Kostka (1976) also tested the effects of participation in environmental activities, both alone and in conjunction with a visit to a nature center. Six hundred children received an environmental attitude scale as a pretest. The experimental subjects then participated in environmental activities during the 2 weeks preceding the visit to their nature center. Control subjects did not. Upon arrival at the nature center, half of the experimental subjects received the attitude scale to determine the effect of the activities. The other half of the experimental subjects took the test immediately after the 2-hour visit. All control subjects received the posttest the day after the experimental subjects' visit. Results showed that posttest scores of the experimental subjects did not differ significantly from those of the controls. However, Kostka did conclude that participation in activities had led to some new appreciations and acceptances of environmental concepts, but there was little change in deeper motivation and involvement. Finally, the pretest scores of inner-city children were significantly lower than those of suburban children, a finding that may be related to that of Wendling et al. (1989) concerning racial differences.

Crater and Mears (1981) used an eighth-grade science class to study the effect of participation in a variety of activities related to an energy unit. Activities included student interviews with older people about the types and sources of energy used 40 to 50 years ago, building solar collectors, making energy conservation posters, writing letters to city officials, and so forth. A science class from a nearby school at the same grade level and using the same text served as a control group. A before-after questionnaire of knowledge and attitudes toward energy problems showed some differences in favor of the experimental subjects, but the authors did not report statistical analyses. However, in the few cases where they did report means and standard deviations, differences in group means did not appear to be statistically significant. Nevertheless, the authors concluded that the students who completed the special energy unit seemed more conservation minded and aware of limited energy sources than those in the control group. Thus, although participation in environmental activities was reported to have a positive effect, the absence of relevant details casts doubt upon that conclusion.

Five studies have used high school students as subjects. Quinn (1976) studied the effects of value sheets (short lessons on current environmental problems accompanied by a series of personally involving questions) on environmental attitudes. Four 10th-grade classes in each of five separate schools participated in this study. One teacher was involved in each of the five schools. Quinn used a Solomon four-group design; two classes in each school received the value sheets and were instructed to complete the sheets at home, hold discussions with friends and family, and have 10-minute discussions with peers the next class day. Value sheets were distributed twice a week for 10 weeks. The other two classes at each school were assigned to the control condition of no value sheets. One experimental and one control class received a pretest attitude survey, and all four groups in each school received a posttest attitude survey. The results indicated that the value sheets did not change the attitudes of the students, although there were significant changes in attitudes as a result of the pretest.

Investigating the notion that training in personal growth and development is integral to successful outcomes in environmental education, Huber, Kyle, and Pizzini (1981) studied environmental attitudes of high school students participating in four 3-week training programs in environmental studies. The posttest-only control group design used 94 students randomly assigned to treatment and control conditions. Students in the two groups were treated alike except for the personal growth and development activities (not described) presented to the experimental subjects by leaders trained to administer such programs. The Inventory for Social Issues (ISI), taken from an unpublished doctoral dissertation, was used as the measure of student attitudes. Overall, experimental subjects scored significantly higher than controls, although the absolute size of the difference was small. Also, on the seven subscales on the ISI, the experimental group scored significantly higher on only one (concern for the problem of increased population and related problems), whereas control groups scored significantly higher on another, seemingly very important scale (desirability of conservation and preservation of the environment). When the four programs were analyzed separately, experimental subjects scored significantly higher than controls only once, a finding that the authors attributed to social interactions between control and experimental groups. Although the authors concluded that personal growth and development activities enhanced participants' appreciation for environmental issues, the small effect size and the confounding social interactions between experimental and control subjects make it difficult to draw any meaningful implications.

A study by Fortner (1985) directly compared classroom instruction with home viewing of a television documentary. Two ninth-grade science classes of one instructor were assigned to watch a 30-minute Cousteau documentary dealing with marine mammals. Three other ninth-grade science classes of the same instructor received classroom instruction covering the same material during the 3 days preceding the program. The five ninth-grade science classes of a second instructor neither watched the documentary nor received classroom instruction. An author-constructed knowledge and attitude scale was administered before and immediately after the treatment, and again 2 weeks later. Results showed significant increases from pretest to posttest for both treatment groups on the knowledge questions, but not for the control group. However, the television group did not differ from the group receiving classroom instruction. The same significant differences in knowledge were also found on the 2-week follow-up test. On the attitude portion of the scale, only the television group showed a significant change on the posttest, but this effect was not maintained on the 2-week follow-up. Although these data suggest that the two presentation formats are equivalent in terms of acquisition of knowledge, the generalizability of the findings is questionable because only a single teacher was involved. A second concern is the amount of time devoted to the classroom presentation. The author stated only that the classroom presentation was "during the three days" before the program, but did not specify the total amount of time.

Jordan, Hungerford, and Tomera (1986) studied training in environmental awareness versus training in awareness plus action strategies. Sixty-two high school students participating in six separate 6-day environmental workshops were assigned to one of two groups. Three groups participating in Eleven Point River Workshops were assigned to the awareness condition, whereas groups participating in three other types of workshops (natural resources, forestry and wildlife management, and soil and water conservation) were assigned to the action strategies condition. Questionnaire data collected at the start of the workshop measured knowledge of action strategies and environmental behavior during the previous 2 months. Differences between the two groups on the pretest were nonsignificant for both measures. The knowledge questionnaire was readministered on the last day of the workshop, and a questionnaire mailed to subjects 2 months after the workshop assessed subsequent environmental behaviors. The group that received action training showed a significant increase in knowledge of environmental actions, as well as reported behaviors, and differed significantly from the awareness group on both posttest measures. The absolute level of reported behaviors was very low, however, with the action group reporting an average of 0.16 behaviors in the 2-month period versus 0.08 for the awareness group. Also, workshop content was confounded with the different treatments.

Lisowksi and Disinger (1991) measured changes in knowledge as a function of participation by high school students in one of three 7-day marine science field programs. Performance on an instrument developed by the experimenters showed a significant difference between pretest and posttest knowledge for students in each of the three programs. Scores on follow-up tests 4 weeks later continued to be significantly different from pretest scores. However, the three programs were not explicitly compared, and the study did not include a control group. Thus, conclusions cannot be drawn concerning the relative effectiveness either of the three programs or of these field programs relative to other techniques. In fact, without a control group, we cannot even be sure that the changes in knowledge were due to the programs.

Two studies focused on college students. Brogdon and Rowsey (1977) attempted to provide prospective science and social studies teachers an interdisciplinary approach to saving the environment that they could eventually incorporate into their classrooms. As part of this training, students were taken on a field trip to an arboretum, where they engaged in several activities designed to heighten environmental awareness. A modified semantic differential type of questionnaire was used to compare attitudes toward the value of the field trip; no significant differences were found between prospective science and social studies teachers. The authors concluded that because there were no significant differences between attitudes of the prospective science and social studies teachers, this technique provides an excellent vehicle for integrating environmental material into both types of classes. However, the absence of any form of control group or measure of change in attitudes prevents us from drawing any conclusions about the effects of the field trip with any of the subjects.

In a second study with college students, Horsley (1977) examined the effect of acting as an agent of change on environmental attitudes and behavior. One hundred eighty-five students enrolled in Geography of Man's Environment, a multisection, freshman-level course, served as the subjects in two identical experiments conducted simultaneously. A Solomon four-group design in which half of the subjects were pretested and half received the treatment was used in each experiment. A 50-item Likert attitude scale, containing value statements about several environmental issues, and a 20-item behavior frequency report were used for the pretest, posttest, and delayed posttest. Students in the treatment groups listened to a presentation in which their assistance was requested in getting two of their friends to engage in pro-environmental behaviors. The students were presented with social learning concepts of reinforcement, modeling, imitation, and role play as ways of convincing people to change their behavior. The same two pretest instruments were administered as a posttest 12 days after the treatment lecture and again as a delayed posttest 7 weeks after the initial posttest. In addition, the experimenter was able to verify directly 12 of the 20 items on the behavior self-report (e.g., letters to Congress, and requests for information at the library).

> **Most of the work we reviewed focused on changes in attitudes, knowledge, or both; only a few studies measured changes in behavior. We believe that this trend is most unfortunate . . .**

Posttest and delayed posttest results both showed that attitudes were not changed significantly by the intervention, quite possibly because students in this course entered with very positive attitudes toward the environment. However, the experimental groups did show a significant increase in reported pro-environmental behaviors. Most important, the unobtrusive measures of actual behaviors indicated that reported behaviors were, in fact, being performed. Thus, this well-designed study showed both an effect that persisted for at least 7 weeks after the treatment and a change in actual behavior of the students requested to encourage pro-environmental behavior in others.

In a study directed at teachers, Dunlop (1979) assessed the effects on 90 in-service teachers of a Workshop on Energy and the Environment presented by the U.S. Department of Energy. These teachers comprised four groups: elementary teachers, secondary science teachers, elementary majors, and arts and sciences majors. The workshop lasted 1 hour, at the beginning of which half of the participants were asked to complete an attitude survey. During the hour, participants were given the opportunity to face simulated situations of the kind encountered by real-life policy makers and to learn more about the complex relationships between energy demands, energy supplies, and environmental pollution. At the end of the workshop, all participants were asked to complete attitude surveys. Results indicated that elementary teachers had the greatest attitude change and the secondary science teachers demonstrated the least change. However, the absence of a control group makes it impossible to determine the absolute effect of the workshop.

In a second study involving adult workshops, Simmons (1984) compared two methods of presenting information concerning hazardous waste-management alternatives. Adult community leaders attended two 1-day workshops, with each workshop constituting a treatment group. One group visited a hazardous-waste facility, and the other group participated in a visit simulated by means of slides. Pretest, posttest, and 3-month follow-up questionnaires were used to assess attitudes and knowledge. For the most part, no significant differences were found between the two treatment groups. Although both groups showed significant changes in attitude and knowledge on the immediate posttest, conclusions about the absolute effectiveness of the workshop are precluded by the absence of a control group. Further, scores returned to near baseline levels on the 3-month follow-up test.

The second serious problem we encountered frequently concerned the measurement instrument that investigators used to assess attitude, knowledge, or reported behavior. Few of these instruments appear to have been constructed by means of rigorous psychometric techniques.

In a final study with adults, Fortner and Lyon (1985) tested the effects of viewing the 30-minute Cousteau documentary that was used in the previously described study with ninth-grade students (Fortner, 1985). Two sets of callers from an independent consulting agency contacted a random sample of 1,000 subscribers to a cable television system and invited them to participate in a study of the effects of a single television program. For participation in the study, subscribers received a small credit on their cable television bill. The treatment group consisted of the first 250 adults who consented to take a pretest, watch the 30-minute documentary, and take an immediate posttest and a retention test 2 weeks after the program. The control group comprised the first 250 adults who agreed to tune in to a specified channel at two different times to take the posttest and the retention test. The pretest was telecast only to the homes of the treatment group, but the posttest was open to any subscriber. Subjects were not used from the treatment group if they did not actually watch the Cousteau program. Subjects who watched the program without being asked to do so were also not included in the control group. A special console attached to the TV set allowed participants to give responses to a questionnaire concerning knowledge and attitudes.

Forty-four experimental and 75 control subjects completed all phases of the experiment. Although the attrition rate was high, the experimenters provided evidence that the sample was not biased. Results were very similar to the study with school children; experimental subjects had higher knowledge scores than controls on both the immediate test and the 2-week follow-up test. Experimental subjects also showed more positive attitudes than controls did on the immediate test but not on the delayed test.

In summary, the vast majority of these studies investigated a single technique relative to a control condition. Investigators used a wide age range of subjects, but none provided data on subjects below the fifth grade. No investigators directly compared different age groups. Only Horsley (1977) included a direct measure of behavior as opposed to relying on questionnaire data. In general, the size of the treatment effects in these studies was small, and few showed clear positive results. We found it encouraging that a number of experimenters did include follow-up measures.

Methodological Issues

Few changes have occurred in the 10 years since Lewis (1981-82) concluded that research methodology generally is weak in environmental education studies. We found several studies that used notoriously weak designs, many others that omitted important details concerning procedures, and many that used weak or inappropriate statistical techniques. Many experimenters who used pretest-posttest designs did not include both measures in a single analysis. Some simply compared groups on the posttest measures after finding nonsignificant differences on the pretest. A few even concluded that there were treatment effects because one group showed a significant pre-post difference, whereas another did not. However, the most common and serious error of analysis we found concerned the unit of analysis. Many experimenters tested existing groups of subjects, most commonly, entire classes of students. Individuals in a class or other intact group clearly do not constitute independent measures, and their responses may be affected by numerous confounding factors other than or in addition to any true treatment effect. Potentially confounding factors when using different classes include differences in teachers, different interactions among students within a class, different school characteristics, and so forth. Yet, most experimenters ignored this problem and used individuals within classes or groups as independent measures. The result is a greatly increased probability of Type I error (rejection of a true null hypothesis). The magnitude of this problem is indicated by Koepke and Flay (1989), who stated, "Type I error rates (for a nominal .05 level) exceeding 50 percent are not uncommon for data analyzed incorrectly at the individual level" (p. 82). Kenny and Judd (1986) presented a thorough review of the problem of violating the assumption of independence among observations.

We found several studies that used notoriously weak designs, many others that omitted important details concerning procedures, and many that used weak or inappropriate statistical techniques.

Of the 34 studies we reviewed, the only 3 with children as subjects that used an appropriate unit of analysis were conducted by Armstrong and Impara (1991), Fennessey et al. (1974), and Ramsey and Hungerford (1989), and only Ramsey and Hungerford found significant effects. Thus, we viewed every other report of positive results described previously with considerable skepticism because the probability of a Type I error is considerably greater than the specified confidence level.

The second serious problem we encountered frequently concerned the measurement instrument that investigators used to assess attitude, knowledge, or reported behavior. Few of these instruments appear to have been constructed by means of rigorous psychometric techniques. As Gray, Borden, and Weigel (1985) pointed out repeatedly, investigators need to be more concerned with the quality and nature of their measurement instruments. Gray et al. stated, "A pervasive problem that prompts further suspicions about the credibility of much of the past attitude-behavior research is the widespread lack of concern with establishing the reliability and validity of the attitude measures employed" (p. 62). Additionally, the vast majority of investigators used a new instrument constructed specifically for the current project. Thus, it became almost impossible make meaningful comparisons of different techniques across studies because the comparability of the measurement instruments was unknown. This problem was also covered in some detail by Gray et al., who concluded, "For the sake of efficiency, continuity, comparability, and quality, future researchers should feel some responsibility to use and further develop inventories already in existence" (p. 36). We believe that careful development of a scale for measuring children's general attitudes and knowledge about the environment should be a high priority for future researchers.

Another methodological problem of concern is the likelihood of strong demand or experimenter expectancy effects in many of the studies. Orne (1962) defined demand as the cues that determine a subject's perception of the experimenter's goals and the subsequent tendency to behave accordingly. Experimenter expectancy effects (reviewed by Rosenthal, 1966) refer to the various ways an experimenter may bias subjects to perform in a way consistent with his or her hypotheses. Experiments promoting pro-environmental attitudes and behaviors often seem highly susceptible to demand or experimenter expectancy effects. This is particularly true either when the measurement instrument is administered immediately after intervention or when the instrument is administered by the same person who presented the intervention. Under either of these conditions, students could ascertain the experimenter's (or teacher's) intentions and be biased toward responding accordingly. For example, the Ramsey and Hungerford (1989) experiment involved 18 weeks of training in specific action skills. Immediately following the training (apparently), the experimenters asked students to report on their own skills in environmental action techniques and their environmental behaviors. Although the report did not describe who administered the instrument or how it was presented to the students, we found it hard to imagine that students under such circumstances would not be inclined at least to exaggerate their own behaviors and skills. Demand, experimenter expectancy effects, or both, provide a plausible alternative explanation for the positive results reported by these authors. We had similar reservations concerning the validity of many of the other experiments described above.

A final methodological concern is that few investigators collect follow-up data to determine whether observed effects persist over time. Transient effects are more likely to result from artifacts such as demand or experimenter expectancy effects. Thus, demonstration that an effect persists over time provides additional evidence of the true impact of the intervention technique. However, even a true impact is of little value if it is lost almost immediately, and practitioners will certainly be most interested in those techniques that have been shown to have a lasting influence. Unfortunately, information concerning durability of effects is seldom provided.

We believe that careful development of a scale for measuring children's general attitudes and knowledge about the environment should be a high priority for future researchers.

Effectiveness of Techniques

Ignoring methodological problems concerning unit of analysis and demand or experimenter expectancies, 14 of the 34 studies reported positive effects and 6 more reported mixed effects (some positive and some negative). The remaining 14 studies either reported negative findings or used a methodology that we judged too weak to allow any conclusions. In the latter category were studies using a one-group before-after design and those that failed to report statistical analyses of their data.

Most of the work we reviewed focused on changes in attitudes, knowledge, or both; only a few studies measured changes in behavior. We believe that this trend is most unfortunate because it is ultimately behavior change that is required to preserve environmental quality. The social psychology literature contains an extensive treatment of the relationships between attitude change and behavior change, and it appears as though the connection is tenuous, at best. (For a succinct summary of this issue, see Baron & Byrne, 1991.) The issue is clouded by the belief of some (e.g., Millar & Tesser, 1989) that attitudes themselves comprise affective and cognitive (i.e., knowledge) components and that the two are not necessarily consistent. Some forms of behavior are thought to be influenced mainly by the affective factor and others by the cognitive factor. However, Gray et al. (1985) stated that the cognitive category must itself be divided into subcategories of facts, principles, and theories and that neither affect nor behavior is likely to be influenced by fragmented factual knowledge. Clearly, there is much to be learned about the relation between attitude and behavior and about the conditions under which changes in attitude are likely to lead to changes in behavior. Nonetheless, most of the studies reported only how an environmental education program affects attitude, knowledge, or both, and very few provided evidence concerning effects upon actual behavior.

Of the five studies measuring either observed or reported behaviors, four found strong effects and the remaining one found a weak effect. Three of the studies that showed strong effects clearly involved either training the subjects specifically for pro-environmental behaviors (Ramsey et al., 1981; Ramsey & Hungerford, 1989) or actually involving the subjects in relevant behaviors (Horsley, 1977). These interventions ranged in length from 12 days to 7 months and involved students ranging from seventh grade to college. The fourth study (Asch & Shore, 1975) investigated fifth-grade students following a 2-year educational program. The fifth study (Jordan et al., 1986) reported a small but significant effect on reported environmental behavior of high school students following action training during a 6-day residential workshop. Although few in number, these studies present an optimistic picture of the potential for increasing pro-environmental behaviors by means of a variety of types and durations of techniques and across a wide range of age groups. Although two of the studies (Horsley, 1977; Jordan et al., 1986) found that the effects of brief interventions (6-12 days) were still present 2 months after the intervention, only Ramsey and Hungerford (1989) used an appropriate unit of analysis (i.e., classes).

The picture is far less encouraging in the 14 studies that targeted attitude exclusively. Only 3 of these studies found strong positive effects (Jaus, 1978, 1982, 1984), and the earliest of these studies evaluated teachers, not students. The two later studies found large and highly significant changes in attitudes of fifth- and third-grade students following 2 to 10 hours of classroom instruction, and in the 1984 experiment this effect was maintained on a 2-year follow-up measure. The reason for such strong and durable effects is not at all clear, although Jaus (1984) suggested that training in the affective domain is crucial. Unfortunately, his paper did not specify how this training was accomplished. Further, the unit-of-analysis problem is maximal because each of his two studies with elementary school children used only two intact classes. Thus, his findings may simply reflect Type I errors. A fourth study (Wendling & Wuensch, 1985; Wendling et al., 1989) reported positive attitude changes in fifth-grade students as a result of participation in various activities, but again, there was only one class per treatment condition. The remaining 10 papers found either mixed or negative effects, or used weak procedures such as a one-group, before-after design. Intervention periods in the studies with negative results ranged from 1 day to a full semester, and subjects' ages ranged from 9 years to college students and teachers. A variety of intervention techniques failed to affect attitudes, including a field trip (Brogden et al., 1977; Kostka, 1976), use of a special manual (Howell & Wambrod, 1974), completion of value sheets (Quinn, 1976), and a camp program (Shepard & Speelman, 1985). We believe that it may be significant that the study that showed the strongest effect on attitudes (Jaus, 1984) used the youngest subjects (third-grade students).

Three studies focused on knowledge acquisition (Bryant & Hungerford, 1979; Howie, 1974; Lisowski & Disinger, 1991), and all found positive effects. These studies used kindergarten children, fifth graders, and high school students, respectively. All three, however, treated intact groups but analyzed individual students, so the possibility of Type I errors was increased. Additionally, the simple before-after design used by Lisowski and Disinger further limits the value of their results.

Finally, 11 studies measured changes in both attitude and knowledge, with only 4 finding positive changes in both. Birch and Schwaab

(1983) showed a positive effect of an instructional unit (duration not specified) on seventh graders, whereas Fortner and Lyons (1985) showed positive effects of a 1-hour cable television program on adults. Hounshell and Liggett (1976) and Aird and Tomera (1977) found instruction increased both attitudes and knowledge of sixth graders, although the knowledge effect was significant at only the .07 level in the Hounshell and Liggett study. Only Fortner and Lyon (1985) used an appropriate unit in their data analysis. Fortner(1985) found mixed results--ninth graders' knowledge was increased both by a television program and class materials, but attitude was changed only by the television program. In this study, individual data were analyzed, although classes were treated as units. Two studies found negative results with both knowledge and attitude. Fennessey et al. (1974) found that 2 weeks of traditional instruction, games, and simulation all had equivalent effects on knowledge and attitudes of third, fourth, and eighth graders. Simmons (1984) found that the effects of an equal visit to a hazardous waste facility were no different from the effects of a slide presentation on either knowledge or attitudes of adults. The final two studies in this group provided little meaningful information. Crater and Mears (1981) did not report results of statistical analyses, and the one-group, before-after design used by Simmons et al. (1977) is subject to potential confounds.

Only 5 of the 34 studies measured changes or reported changes in environmentally relevant behaviors. Although changes in knowledge or attitudes are important, we believe that changes in behavior will ultimately affect the quality of our environment.

Conclusions

Although several of the studies in this review appeared to have found positive effects on environmental attitudes, knowledge, and behavior, much of the utility of these findings was mitigated by problems of experimental design and data analysis. Some notable exceptions (e.g., Armstrong & Impara, 1991; Horsley, 1977) should serve as models for future research on the impact of environmental education. Investigators in the field must become more sensitive to the importance of rigorous designs that include meaningful control groups, controls for expectancy effects, use of reliable and valid dependent measures, follow-up data, and appropriate unit analyses.

None of the studies addressed environmental education strategies for getting children to encourage others (e.g., their parents) to change environmentally relevant behaviors. Horsley's (1977) early success in using this approach with college students suggests that this is a potentially fruitful area of research.

Researchers have also neglected working with children in the lower grades. Although an early study by Bryant and Hungerford (1979) found positive results with kindergarten children, no other investigators have used subjects below the third-grade level. Thus, another potentially fruitful area of research is the effects of environmental education with young children. In fact, even very young children may serve as effective agents of change, as demonstrated by Geller (1989).

Only 5 of the 34 studies measured changes or reported changes in environmentally relevant behaviors. Although changes in knowledge or attitudes are important, we believe that changes in behavior will ultimately affect the quality of our environment.

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Predictors of Responsible Environmental Behavior: A Review of Three Dissertation Studies

Tom Marcinkowski

In this reading, Dr. Marcinkowski takes the reader on a journey through what environmental educators think and theorize about REB (Responsible Environmental Behavior). The author delves into three major studies dealing with the predictors of REB and then provides a detailed discussion of the implications and impacts of these studies. Although this reading is not for the faint-of-heart, it provides, for the first time, a look at three very closely related studies completed by Drs. A. P. C. Sia, Dan Sivek, and Tom Marcinkowski himself, mostly in the decade preceding the '90s. This body of research has enormous implications for practice in the field of EE and should be looked at closely by anyone involved in instructional design and/or curriculum development in environmental education.

Introduction

The purposes of this paper are to:

- present an overview of dissertation studies on predictors of responsible environmental behavior conducted by Sia (1984), Sivek (1989) and Marcinkowski (1989);
- provide sufficient background material which will permit these studies to be viewed "in context";
- provide comparative analyses of these three studies; and
- offer comments on the recommendations from, implications of, and impacts of these studies.

These studies were selected for review in this paper for two reasons. First, all three studies investigated the efficacy of the same eight predictor variables and utilized nearly identical measures of those variables and of the dependent variable, responsible environmental behavior (REB). Consequently, there is a methodological consistency to these studies which permits their results to be viewed on a comparative and collective basis. As Hines (1985) pointed out, this is unusual. She found it was very difficult to compare and integrate the results of studies of correlates and predictors of REB because of the wide variation in models and measures of variables employed in such studies.

Second, these three studies appear to be the first to investigate a broader set of predictor variables and a broader measure of REB than was common at that time. During the 1970s and 1980s, many studies of predictors of REB investigated a few predictor variables and/or a limited range of environmental behaviors (e.g., recycling, consumer practices, energy conservation) (Marcinkowski, 1989). This commonly happens in relatively new research areas, where prior knowledge and methodology are limited, and research purposes vary. Early studies often help build the knowledge base and advance methodology. Nonetheless, studies which investigate a limited range of predictor variables and behaviors have limited generalizability and therefore tend to be of limited educational value. When broader sets of predictor variables and broader measures of REB are explored, as in these three studies, the range of applicability of the results increases, as does the potential for something of educational value to emerge. In these studies, eight (or more) predictor variables were drawn from prior research for investigation. Further, the measure of REB used encompassed the five categories of action posed by Hungerford and Peyton (1980), categories which have been investigated in more than a dozen theses, dissertations and funded research projects.

Contexts for Interpreting the Three Studies

From the perspective of ecological psychology, Maloney and Ward (1973) discussed "the eco-

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logical crisis [as] a crisis of maladapative behavior" (p. 583) and suggested that a "reconceptualization of the problem in terms of human behavior dictates a solution in terms of altering that same behavior" (p. 584). Today, twenty-five years later, few people would argue that human behavior, individually and collectively, has significantly affected the majority of documented environmental problems. Some have pointed out that large business, industrial and governmental entities contribute at least as much to these problems and to their solution as the individual and collective behavior of citizens. Nonetheless, one may define the contributions of such entities as a function of the individual and collective behavior of individuals who work for them (e.g., decision-making behavior).

The Importance of Problem-Solving Behavior in EE

Writers in the field of EE have consistently stated that attention to environmental problems and their solutions serve as primary rationales for [as well as] characteristics of and purposes of EE (Stapp, 1969; Harvey, 1976, 1977; Schmeider, 1977; Hart, 1980, 1981; Disinger, 1983; Simmons, 1995). This emphasis on problem-solving behavior is apparent in the EE goals and objectives agreed to during the U.N.'s Intergovernmental Conference on EE held in Tbilisi in 1977. Governments represented at Tbilisi affirmed that changes in behavior were needed and were of particular interest to the field environmental education: "The goals of environmental education are ... (c) to create new patterns of behavior of individuals, groups and society as a whole towards the environment" (Unesco, 1978, p. 26). Further, one of the five categories of objectives set forth at Tbilisi featured the need "... to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems" (Unesco, 1978, p. 27). The goals and objectives adopted at the Tbilisi Conference have been reaffirmed by the environmental education community numerous times since 1977 (Gustafson, 1983; Unesco, 1987; Knapp, 1997), and have served as the basis for at least one major set of EE curriculum goals (Hungerford, Peyton, & Wilke, 1981). It is understandable that more recent attempts to develop environmental literacy frameworks and to set forth guidelines for environmental learning have featured behavior and behavior-related variables as critical components (Roth, 1992; Simmons, 1995, 1997; Wilke, 1995).

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Defining "Responsible Environmental Behavior"

The three dissertation studies featured in this paper set out to investigate variables associated with the kinds of problem-solving behavior called for in the EE literature, hereafter referred to as "responsible environmental behavior" (REB). Just what is meant by or encompassed by this term? Van Liere and Dunlap (1981) presented REB as an expression or dimension of environmental concern which consisted of "activities that have been suggested as ways people can help solve environmental problems" (p. 662). Maloney and Ward (1973) defined REB in terms of what commitments people do make (i.e., Actual Commitment). These and other writers (e.g., Lipsey, 1977; Cook & Berrenberg, 1981) have suggested that REB should encompass the range of observable behaviors "aimed at" or "intended to" contribute to the solution of environmental problems. This serves as the broad definition of the "construct" of REB in this paper and in the featured dissertation studies. It is this broad meaning that allowed Sia (1985) and Hines (1985) to suggest that REB is equivalent to other terms which appear in the literature, such as pro-ecological behavior, pro-environmental behavior, environmental action and environmental problem-solving.

As part of his dissertation study, Peyton (1978) undertook a review of the literature in an attempt to further define REB. Out of this work, Hungerford and Peyton (1981) defined REB as comprising: (a) categories of action; (b) levels of action; and (c) criteria for analyzing proposed actions. The five categories of action posed by Hungerford and Peyton (1980, p. 149) were: ecomanagement, consumerism (consumer action), persuasion, political action, and legal action. In simple term, these categories of action have been defined as follows (Wilke, 1995):

- Ecomanagement: refers to those environmental actions in which people work directly with the natural world to help prevent or resolve environmental issues;

- Consumer action and economic action: refer to those environmental actions in which people use monetary support or financial pressure to help prevent or resolve environmental issues;

- Persuasion: refers to those environmental actions in which individuals or groups appeal to others to help prevent or resolve environmental issues;

- Political action: refers to those environmental actions in which people use political means (e.g., political processes, organizations, parties, or offices) to help prevent or resolve environmental issues; and

- Legal action: refers to those environmental actions which people use to support or enforce existing laws which are designed to help prevent or resolve environmental issues.

While there have been changes in terminology (e.g., consumerism relabeled as consumer/ economic action) and in definitions for these categories, the meaning and use of these categories have remained reasonably consistent over the past two decades. These categories provided the framework for the measure of REB used in prior studies (e.g., Ramsey, 1979; Klingler, 1980; Childers, 1981) and in the three dissertation studies featured in this paper.

In addition, Hungerford and Peyton noted that "environmental action results from the activities of either an individual or a group of individuals working cooperatively" (1981, p. 150). They further pointed out that groups may work at a variety of "levels" which range from community groups working at the neighborhood level to international organizations working at the global level.

Finally, Hungerford and Peyton posited "... that a particular action decision needs to be analyzed and evaluated before it is taken" (1981, p. 150). To support this kind of analysis and evaluation, they presented 14 "action analysis criteria" which are intended to be used before any action is taken, as well as to increase the clarity, sophistication and effectiveness of proposed actions. Readers familiar with these criteria are no doubt aware of examples of actions which would not meet all of these criteria (e.g., recyclable materials collected in school recycling bins which get diverted to dumpsters and landfills; energy conservation efforts in homes which do not reduce meter readings; introducing predators to a new area in an effort to remove exotics which then contribute to unforeseen ecological impacts). Should these and other actions be considered as examples of REB if they are intended to help resolve environmental problems but do not lead to this intended outcome? This question is raised to alert readers to the fact that the broad definition of REB presented earlier in this section does not address conceptual issues raised by these criteria, such as may arise for actions which exhibit inconsistencies between intentions and outcomes.

Attention to REB in EE Practice

With the attention given to the role and definition of REB in EE over the past two decades, one might think that EE practice would, by now, readily address REB and associated variables. There is some evidence of increased attention to these in some areas of EE practice (e.g., Wilke, 1985; Simmons, 1991). Nonetheless, it is unfortunate that needs assessments and status studies conducted across various sectors of the field, both prior to and since the featured dissertation studies, indicate that objectives associated with REB are not being addressed at a level commensurate with their stated importance (Peyton, 1978; Childress, 1978; Champeau, Gross & Wilke, 1980; Volk, 1983; Stevenson, 1986; Pomerantz, 1990-91; Simmons, 1991; McKeown-Ice, 1995). Given the apparent disparity between the stated importance of such behavior to EE and practice in the field of EE, there is a clear and convincing need to better understand REB through research.

> **With the attention given to the role and definition of REB in EE over the past two decades, one might think that EE practice would, by now, readily address REB and associated variables. . . . it is unfortunate that needs assessments and status studies conducted across various sectors of the field . . . indicate that objectives associated with REB are not being addressed at a level commensurate with their stated importance.**

Traditional vs. Research-Based Thinking about REB

One of the contributing factors to this disparity between the importance of REB and practice related to REB in EE stems from the increasing disparity between the evolving body of research evidence about REB and traditional thinking about how to address REB in practice. Traditional thinking is reflected in what has come to be known as the knowledge-attitude-behavior (K-A-B) model. This model has been critiqued by Peyton (1981), Sia (1985), Hines (1985), Marcinkowski (1989), Hungerford and Volk (1990), and Simmons (1991).

What kinds of assumptions are reflected in this model? Hungerford and Volk (1990, p. 9) quote Ramsey and Rickson (1976, p. 10) as indicating that "*increased knowledge* leads to *favorable attitudes* ... which in turn lead to *action* promoting better environmental quality" (emphases added). Marcinkowski (1989, p. 95) offered a similar quote from Birch and Schwaab (1983, p. 30): "As previous research indicates ... the assumption must be made that *informed attitudes* will lead to subsequent water *conservation behavior* ... Further research should attempt to offer empirical evidence that *knowledge and attitude gains* resulting from the water conservation unit will influence a student's *behavior* regarding efficient water use" (emphases added). Finally, in analyzing the goals of 1,225 nature and environmental centers, Simmons (1991) reported that about two-thirds of the responding centers identified goals which reflected knowledge-behavior and/or K-A-B models. These anecdotes provide some insight into the nature and pervasiveness of K-A-B thinking in the field.

Iozzi (1981, 1984), Hines (1985), and others have reported that attitude is by far the most commonly studied variable in EE, a circumstance which both reflects the pervasiveness of thinking about the role of attitudes (i.e., within the K-*A*-B model) *and* provides the research evidence to assess and critique this role. With respect to the knowledge-attitude (K-A) portion of the K-A-B model, Peyton (1981) presented a review of 21 studies which investigated this relationships. His review, and Marcinkowski's subsequent research review (1989, pp. 94-97), revealed a more complex relationship between knowledge and attitude than is implied in the K-A-B model. Research evidence indicates that: (a) the strength of the K-A relationship is contingent upon the particular dimension(s) of knowledge and attitude of interest, and (b) even when these are well matched, this relationship may be non-linear and can change over time.

Similarly, reviews of research on the attitude-behavior (A-B) relationship (Sia, 1985, pp. 66-67; Marcinkowski, 1989, pp. 97-101) indicated that: (a) as with K-A, the strength of the A-B relationship is contingent upon the dimension(s) and levels of both attitude and behavior; (b) the strength of this relationship also appears to be contingent upon or an artifact of measurement conditions; and (c) while attitude is one of several variables influencing behavior, there appear to be other variables which may moderate or influence the attitude-behavior relationship.

Evidence to support critiques of the K-A-B model can be found in other bodies of research, including Fishbein and Ajzen's work (1975, 1977) and research in the "diffusion-adoption" tradition (Rogers, 1995). Rogers reported that "KAP studies are sample surveys of *knowledge* (K), *attitudes* (A), and adoption of the *practice* (P) of family planning innovations ... [M]ost national family planning programs have found it much easier to diffuse *knowledge* about contraceptive methods (K) and to achieve *favorable attitudes* toward family planning (A), than to secure the widespread *adoption and practice* of contraception (P) by the target audience. Thus, KAP surveys often find a 'KAP-gap' with a relatively high percentage of knowledge and favorable attitudes toward family planning methods ... but a relatively low rate of adoption ... *Knowledge gain* and *attitude change* can be achieved more easily than can *adoption* of family planning methods" (1995, pp. 70-71; emphases added). Reviews of the research literature within and outside the field have clearly indicate[d that] the K-A-B model is inadequate to guide EE practice. If

REB is to given more than lip-service in EE, a more adequate knowledge base has to be constructed through research to inform and guide practice.

> Reviews of the research literature within and outside the field have clearly indicate[d that] the K-A-B [knowledge-attitude-behavior] model is inadequate to guide EE practice. If REB is to given more than lip-service in EE, a more adequate knowledge base has to be constructed . . . to inform and guide practice.

An Evolving Research Base for These Dissertation Studies

At the outset of Sia's (1985) dissertation study, both the pervasiveness and the limitations of the K-A-B model were just being recognized. By the time Marcinkowski (1989) and Sivek (1989) engaged in their studies, this dual reality was reasonably clear to the wider EE research community. Thus, these dissertation studies were not limited to the variables in the K-A-B model. Where did these researchers find additional research evidence on which to base their selection of possible predictor variables? The real answer to this question can be found in the literature reviews of each of the three dissertation studies. Space will permit only a brief summary of that research literature here. Readers who have a deeper interest are encouraged to obtain these dissertations and read the full literature reviews.

At the time Sia began his dissertation study, the literature on REB was largely unorganized and had been interpreted on a very limited basis.

At the time Sia began his dissertation study, the literature on REB was largely unorganized and had been interpreted on a very limited basis. He quoted Maloney and Ward in characterizing the state of this body of research: "To date there is a paucity of data available to help in the understanding, prediction, and modification of these behaviors (1973, p. 584, as quoted in Sia, Hungerford & Tomera, 1985/86, p. 31). He did have available the first report of NAAEE's Research Commission (Iozzi, 1981) and several early interpretations of that body of research (Fryman, et al., 1982; Hungerford, Tomera, & Wilson, 1983) as openings into the literature on REB. Using these, he found prediction studies by Arbuthnot (1977) and Borden, et al. (1978, 1979a, 1979b) which helped him identify several predictor variables warranting further investigation (i.e., locus of control, attitudes towards pollution and technology, and psychological gender role).

His [Sia's] familiarity with experimental-type studies featuring knowledge of and skill in using environmental action strategies (Ramsey, 1979; Klingler, 1980) and with descriptive studies in (then) a new research area referred to as "environmental sensitivity" (Tanner, 1980; Peterson, 1982) led to the identification of additional variables for his investigation. Sia was able to both expand and refine his understanding of prior research on REB by comparing these and other variables to those included in an evolving model of "environmental literacy" (Hungerford & Tomera, 1985) and by working closely with Hines as she summarized and then synthesized research on REB (Hines & Hungerford, 1984; Hines, 1985). While Sia's efforts to base his work on prior research was common and expected, his use of a model of environmental literacy to guide development of a model of predictors of REB was unique.

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By the time Sivek (1989) and Marcinkowski (1989) began their dissertation studies, both Sia's study of predictors of REB (1985) had Hines' (1985) meta-analysis of correlates of REB had been recently completed. The literature reviewed in and the findings report in these two studies provided the impetus and guidance for Sivek's and Marcinkowski's studies. Since the findings of Sia's (1985) study will be reported in the next section of this paper, only Hines' findings will be summarized here (Hines, Hungerford & Tomera, 1986/87, p. 3, Table 1; see Table 1).

Since Sivek's (1989) study was a replication of Sia's (1985) study using differing sample populations, additional research on REB had limited influence on the design of his study. However, since Marcinkowski's (1989) study was a

Table 1.

Summary of Hines' Meta-Analysis Results for Descriptive Studies

Variable	Corrected correlation coefficient	Corrected standard deviation	Number of values based on
Verbal commitment	.491	.130	6
Locus of control	.365	.121	14
Attitude	.347	.224	51
Personal responsibility	.328	.121	6
Knowledge	.299	.195	17
Education level	.185	.122	11
Income	.162	.084	10
Economic Orientation	.160	.118	6
Age	-.151	.200	10
Gender	.075	.084	4

Note: Several studies reported data on more than one variable.

replication-and-extension of Sia's (1985) study, additional research on REB was of greater relevance to his study design. Marcinkowski (1989) sought out variables which might serve as correlates and predictors of REB above-and-beyond those investigated by Sia. In selecting additional variables, he relied heavily upon the results of Hines' literature search and meta-analysis. Hines' hard work indicated that the research literature on REB was more extensive than Sia had been aware of. However, she found this literature remained difficult to access and interpret since it was conducted in a wide array of fields using differing theoretical frameworks, models and measures, and was reported in a diversity of research journals. In a wider search of the literature on REB, Marcinkowski (1989) found earlier reviews of the REB research literature (Lipsey, 1977; Cook & Berrenberg, 1981), as well as a large number of correlation and prediction studies in a variety of fields interested in differing kinds of REB (e.g., marketing and consumer research, energy conservation, soil and water conservation, voting behavior, and so on). Hines' (1985) results, these additional reviews of research, and the array of other studies of correlates and predictors helped Marcinkowski identify additional variables for his investigation.

Summary of Conditions Influencing and Driving These Studies

In summary, these three dissertation studies should be seen as indicators and products of their times. Interest in and attention to REB in psychology and in EE was growing throughout the 1970s. This led to efforts to understand and describe important aspects of REB. In the 1980s, early reviews of EE research provided a mirror which helped the field recognize the character of and limitations of its thinking about REB (e.g., the K-A-B model) and stimulated interest to know more. On the heels of seminal studies in the later 1970s and early 1980s came the awareness of a more expansive research literature and a growing interest in interpreting and summarizing it. The fruits of these efforts, in turn, led to significant shifts in our understanding about the design of research into REB.

Unfortunately, needs and status studies indicate that this research "growth spurt" experienced in the 1980s was not accompanied by, and has yet to be reflected in, EE practice. Thus, there remains a substantial need to expand and refine research in the area of REB and associated areas of EE, as well as an ongoing need to interpret this body of research so that its implications for EE practice can be more clearly understood.

An Overview of Prediction Studies by Sia, Sivek and Marcinkowski

Each of these three dissertation studies of predictors of REB will be summarized next. The following outline will be used to present a summary of each:

- Research Problem and Purpose(s);

- Research Questions;
- Predictor and Dependent Variables;
- Sample Population(s) and Sampling Procedures;
- Instrumentation and Validity/Reliability;
- Data Collection and Analysis Procedures; and
- Major Results and Conclusions.

Readers who are interested in a more in-depth treatment of these studies are referred to reports of these studies in the journal literature (Sia, Hungerford, & Tomera, 1985/86; Sivek & Hungerford, 1989/90), or to the full dissertations (Sia, 1985; Sivek, 1989; Marcinkowski, 1989).

Sia's (1985) Study of Predictors of REB

The problems Sia perceived are outlined in the previous section of this paper: (a) there was a paucity of research on REB; (b) of the research that had been conducted, no more than 15% of the variance (i.e., variability in scores) of REB had been explained; and (c) of the various explanations for this, Sia attributed this to "... a lack of theory in past environmental research ..." (1985, p. 6).

Thus, the purposes of his study were:

- to develop and test "... a theoretical framework for environmental behavior prediction ..." (1985, p. 6); and
- "... to take [this] study's findings and use them to direct future research in citizenship responsibility and to provide direction for curriculum development where the development of responsible citizenship behavior is of paramount concern" (1985, p. 10).

Given these, Sia posed the following research questions to guide his study:

"1. To what extent can overt environmental behavior be predicted by the following variables:
   (a) Level of Environmental Sensitivity,
   (b) Perceived Individual Locus of Control,
   (c) Perceived Group Locus of Control,
   (d) Perceived Knowledge of Environmental Action Strategies,
   (e) Perceived Skill in Using Environmental Action Strategies,
   (f) Belief about/Attitude towards Pollution,
   (g) Belief about/Attitude towards Technology, and
   (h) Psychological Sex Role Classification?

2. Do these predictor variables operate similarly for high and low activist groups (as measured by total environmental action scores on five action categories)?

3. What is the most parsimonious set of variables which best predicts responsible environmental behavior?" (Sia, 1985, pp. 10-11)

As noted in his second research question, the dependent variable in Sia's study was REB as measured across the five categories of action posed by Hungerford and Peyton (1981). The set of variables Sia investigated as potential predictors of this set of REB scores were the eight identified in his first research question, drawn from prior research and a theoretical framework (Hungerford & Tomera, 1985).

Sia chose two distinct groups to participate in his study:

> Sierra Club (SC) and Elderhostel (EH) members. Both were samples of convenience. A random sample of Sierra club chapters was generated from a list of local chapters in the states of Illinois and Wisconsin. This SC sample responded by mail. The second sample, the EH members, was given the instrument while in workshop attendance at the Southern Illinois University-Carbondale Touch of Nature Environmental Center. One hundred seventy-one (171) usable instruments were collected (SC=105; EH=66). (Sia, Hungerford & Tomera, 1985/86, p. 33)

The instrument he developed to collect data from these samples consisted of seven sections. The first was a demographic section designed to collect information about respondent characteristics (e.g., gender, age range, education level). These variables were used to describe each sample, and were not explored as potential predictors of REB. The second section was (BIEA) the five-category measure of REB: consumerism (consumer action), physical intervention (ecomanagement), persuasion, political action and legal action. Respondents were provided with definitions of and a list of six actions for each category, and were asked to identify up to two additional actions in each category. Respondents were then asked to identify how frequently they recalled engaging in a each listed and self-identified action over the past year using a scale with values ranging 0 to 5+. Sections three (3) through seven (7) of his instrument contained measures of the eight predictor variables.

> The [3] LES provided an environmental sensitivity score based on those variables identified in Peterson's (1982) study. The [4] EAKS assessed respondents' knowledge of and skill in using environmental action strategies. Respondents were also assessed regarding their perceived ability to influence the solution of environmental problems/issues [locus of control], either as an individual or working with a group ([5] ILOC & GLOC). The [6] PAQ provided data for categorizing respondents into four psychological sex role classifications, namely, androgynous, cross-typed, traditional sex-role, and undifferentiated (Spence and Helmreich 1978). The [7] PTQ assessed (in semantic differential format) respondents beliefs in/attitudes toward pollution and technology." (Sia, et al., 1985/86, p. 32)

Regarding the reliability and validity of these sections, Sia reported the following. First, construct validity and reliability estimates for the PAQ were drawn from the work of Spence, Helmreich and Stapp (1975). Second, content validity estimates for sections two through five and section seven were generated by a panel of five science/environmental educators. Third, the following test-retest reliability values were generated using samples of college students majoring in forestry and in education:

- BIEA: r=0.74 (forestry students) and r=0.92 (educ. students);
-
- LES: r=0.63 (forestry students);
- EAKS: r=0.82 on perceived knowledge, and r=0.79 on perceived skill (forestry students); and
- ILOC, r=0.45 and GLOC, r=0.80 (forestry students).

The data collected using the seven sections of this instrument were subjected to six kinds of data analysis: (a) descriptive statistics for and intercorrelations among all variables; (b) quartiling scores on his measure of REB, the "Behavior Inventory of Environmental Action" (BIEA); (c) ANOVA and regression analyses to compare high and low behavior score quartiles, and to compare SC and EH samples; (d) intercorrelations between the BIEA scores and predictor variable scores; (e) multiple regression analyses to determine the zero- and first-order contributions of the predictor variables to an explanation of the variance in BIEA scores; and finally, (f) a maximum r-square improvement form of stepwise regression analyses to identify the most parsimonious set of predictors for the total sample, SC sample and EH sample (Sia, et al., 1985/86, p. 33).

The results of these analyses are reported in full by Sia (1985), and have been summarized by Sia, et al. (1985/86). Only those results which pertain to the analyses of data from the total sample and to his comparison of high and low behavior score quartiles will be outlined here, since these provided the most direct responses to Sia's research questions and are the most relevant to EE theory, research and practice.

The total sample was divided into high, medium and low behavior score groups (i.e., quartiles) as indicated in Table 2 (Sia, et al., 1985/86, pp. 33-35). From the data presented in Table 2, several things are apparent. First, as expected there was a substantial difference in the range and mean on BIEA scores between the low and high behavior (quartile) groups. Second, the SC sample tended to report more actions than did the EH sample, so the proportion of SC to EH members varied in each quartile (e.g., the number of SC members in the high behavior group was greater than for the EH groups). Third, as expected, the high behavior group scored substantially higher on scores in each category of action (i.e., action subscales) included in BIEA. Finally, there were noticeable differences between the mean scores of the low and high behavior groups for most of the eight predictor variables. The high behavior group scored higher than the low behavior group on the measure of environmental sensitivity (LES range: 15-75 pts.), measures of knowledge of and of skill in using action strategies (EAKS/knowledge and skill range: 5-25 pts. each), and measures of individual and group locus of control (ILOC and GLOC range: 5 -

Table 2.

Results of Sia's Quartiling and Analysis of the Total Sample Using BIEA Scores

	BIEA Score Quartiles		
Grouping	1st Quartile (Low)	2nd & 3rd Quartiles (Medium)	4th Quartile (High)
BIEA Range	0 - 19	20 - 49	50 - 117
Total Sample	n=45 (26%)	n=80 (47%)	n=46 (27%)
* SC Sample	n=19 (18%)	n=53 (51%)	n=33 (33%)
* EH Sample	n=26 (39%)	n=27 (41%)	n=13 (20%)
BIEA Means	x = 16.01		x = 69.3
* Ecomanagement	x = 8		x = 27
* Persuasion	x = 5		x = 18
* Consumer	x = 2		x = 12
* Political	x = 0.95		x = 10.7
* Legal	x = 0.06		x = 1.6
Predictor Means			
* LES	x = 35.11		x = 49.57
* EAKS/Knowl.	x = 13.13		x = 17.41
* EAKS/Skill	x = 9.71		x = 14.83
* ILOC	x = 2.42		x = 3.15
* GLOC	x = 3.31		x = 4.04
* PAQ	x = 2.76		x = 2.07
* PTQ/Pollut.	x = 14.56		x = 11.48
* PTQ/Technol.	x = 31.13		x = 29.11

Note: BIEA = Behavior Inventory of Environmental Action

25 pts. each). At the same time, the low behavior group scored higher on measures of beliefs/attitudes toward pollution and toward technology (PTQ/pollution and technology range: 6-42 pts. each), thereby evidencing more positive environmental attitudes. All of these high/low behavior group differences, save for the PTQ/technology measure, were statistically significant at $p<.01$. Viewed collectively, these differences between low and high behavior (quartile) groups indicated that his measures were sufficiently sensitive to detect between-group difference, and thereby provided additional evidence of the construct validity of these measures.

> **. . . as expected, the high behavior group scored substantially higher on scores in each category of action (i.e., action subscales) included in BIEA.**

The results of his correlational and regression analyses are of particular interest here, since these results can be compared to those obtained by Sivek (1989) and Marcinkowski (1989). The strength of the relationship of scores on each predictor to BIEA scores are reported in Table 3 (Sia, et al., 1985/86, p. 37). Sia (1985) reported that seven of the eight predictor variables he investigated were significantly related to BIEA scores ($p<.05$), a finding which confirmed his selection of those variables from prior research. These findings also provided further empirical support for the theoretical model of environmental literacy he was using as a reference and guide.

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Table 3.

Results of Sia's Analysis of the Correlation Between Each Predictor Variable and BIEA Scores

Measure	Predictor Variable	Correlation to BIEA
LES	Level of Environmental Sensitivity	.56 *
EAKS	Perc. Know. of Action Strategies	.55 *
EAKS	Perc. Skill using Action Strategies	.59 *
ILOC	Perc. Individual Locus of Control	.38 *
GLOC	Perc. Group Locus of Control	.39 *
PAQ	Psychological Gender Role	- .39 *
PTQ	Beliefs/Attitudes towards Pollution	- .26 *
PTQ	Beliefs/Attitudes towards Technology	- .08

Note: Under the "Correlation" column, * = significant at $p<.05$

Sia conducted zero-order, first-order and stepwise regression analyses to explore the extent to which his eight variables served as statistical predictors of BIEA scores. Zero-order regression analyses were conducted to determine the degree to which each variable, alone, was able to explain the variance (variability) in BIEA scores. Mathematically, the results are the squares of the correlation values reported in Table 3 (above), with resulting "explained variance" values ranging from 0.00 (0%) to 1.00 (100%). However, Sia had previously determined that his eight predictor variables were correlated to each other, as well as to BIEA scores (e.g., for knowledge of and skill in using action scores, r=.74). Given this, he recognized these zero-order values could not simply be "added up" since they "shared" smaller to greater portions of the explained variability in BIEA scores. Therefore, he used first-order regression analyses to determine the degree of unique variance explained by each variable; (i.e., the degree of variance explained after the variance shared with other predictors had been mathematically removed). He found that five of his eight selected variables served as statistically significant predictors of BIEA scores: LES, EAKS/Skill, PTQ/Technology, EAKS/Knowledge, and PAQ ($p < .05$; Sia, 1985; Sia, et al. 1985/86, p. 37).

Sia's last research question focused on the development of a "parsimonious" set of predictor variables. In essence, this question asked "What is the smallest set of predictors one can use to maximize the explained variance in BIEA scores?". To determine this, Sia conducted stepwise regression analyses. This procedure selects the strongest predictor and enters it first into a regression equation, then selects the predictor which makes the next greatest contribution to explained variance and enters it as the second variable, and so on, until the weakest predictor has been entered last. Typically, the last predictor(s) entered into a regression equation add(s) little, if anything, to an explanation of variance in a dependent variable. The results of Sia's stepwise analysis are presented in Table 4 (Sia, 1985, pp. 138; Sia, et al. 1985/86, p. 38).

. . . "What is the smallest set of predictors one can use to maximize the explained variance in BIEA scores?". To determine this, Sia conducted stepwise regression analyses. This procedure selects the strongest predictor and enters it first into a regression equation, then selects the predictor which makes the next greatest contribution to explained variance and enters it as the second variable, and so on, until the weakest predictor has been entered last.

Table 4.

Results of Sia's Stepwise Regression Analyses for the Total Sample (n=171)

Predictor Variables	R-Square Values	% Explained Variance	F Value	Probability
- Perceived skill in using env. action strategies (df = 1, 169)	.3454	34.54%	89.16	.0001 *
- Level of env. sensitivity (df = 2, 168)	.1292	47.46%	41.31	.0001 *
- Perceived knowl. of env. action strategies (df = 3, 167)	.0178	49.24%	5.87	.0165 *
- Belief in/attitude toward technology (df = 4, 166)	.0097	50.21%	3.24	.0737
- Psychological sex role classification (df = 7, 163)	.0093	51.14%	3.14	.0784
- Belief in/attitude toward pollution (df = 8, 162)	.0057	51.71%	1.92	.1673
- Perceived indiv. locus of control (df = 9, 161)	.0036	52.07%	1.25	.2649
- Perceived group locus of control (df = 10, 160)	.0008	52.15%	0.24	.6261

Note: Under the "Probability" column, * = significant at $p<.05$

The results of Sia's stepwise analysis presented in Table 4 clearly indicated at least two things. First, it was possible to explain more than 15% of the variance in REB, despite the conventional wisdom at that time. In this case, Sia was able to account for more than half (52.15%) of the variance in BIEA scores, which ranged from 3 to 117. Second, he found that the first three variables entered into the regression equation were his only statistically significant predictors, and these accounted for the vast majority of that level explained variance (49.24%).

Sivek's (1989) Study of Predictors of REB

The research problems Sivek (1989) perceived relate to Maloney and Ward's (1973) and Sia's

(1985) comments regarding the "paucity" of research in the area of REB.

> As a result of this deficiency, Hines, et al. recommended that "additional research is needed ... to discover those interrelationships which exist between each of the variables ... To accomplish this, research efforts must concentrate on all factors in the environmental behavior picture, rather than continuing to isolate individual components from those variables with which they likely interact." (Hines et al., 1986/87) (Sivek, 1989, p. 6)

Given this, the purposes of Sivek's study were:

- to "respond to this [Hines et al.'s 1986/87] recommendation;
- "to replicate the research of Sia, Hungerford, and Tomera (1985/1986) who assessed predictors of responsible environmental behavior of Sierra Club and Elderhostel samples; and
- "to assess the relative contribution of eight selected variables to the prediction of responsible environmental behavior of members of the Wisconsin Trappers' Association (WTA), members of the Wisconsin Chapter of Trout Unlimited (TU), and Wisconsin members of Ducks Unlimited (DU)." (Sivek & Hungerford, 1989/90, p. 36)

Sivek posed the following research questions to address these purposes and guide his study:

> "1. To what extent can overt environmental behavior in samples of members of the Wisconsin Council of Trout Unlimited, the Wisconsin Trappers' Association, and Wisconsin members of Ducks Unlimited be predicted by the following variables:
>
> (a) level of environmental sensitivity,
> (b) perceived individual locus of control,
> (c) perceived group locus of control,
> (d) perceived knowledge of environmental action strategies,
> (e) perceived skill in using environmental action strategies,
> (f) belief about/attitude towards pollution,
> (g) belief about/attitude towards technology, and
> (h) psychological sex role classification?
>
> 2. What is the most parsimonious set of the selected variables that best predicts overt environmental behavior in samples of the Wisconsin Council of Trout Unlimited, the Wisconsin Trappers' Association, and Wisconsin members of Ducks Unlimited?
>
> 3. To what extent do samples of the Wisconsin Council of Trout Unlimited, the Wisconsin Trappers' Association, and Wisconsin members of Ducks Unlimited differ from a selected Sierra Club sample (Sia et al., 1986/86) with regard to the most parsimonious set of variables that best predict environmental behavior?" (Sivek, 1989, pp. 17-18)

The variables under investigation and the instrumentation used in this study are readily apparent in Sivek's stated purposes and research questions. "A survey was adapted from Sia et al. (1985/86) that assessed the eight predictor variables and the respondent's level of responsible environmental behavior over a one year period" (Sivek & Hungerford, 1989/90, p. 36). Sivek goes on to add that "Validity and reliability coefficients for each section of the survey instrument were reported by Sia et al. (1985/86)" (Sivek & Hungerford, 1989/90, p. 36).

Sivek's samples were selected, surveyed and organized as follows:

> Two hundred randomly selected subjects from each of the memberships of WTA, TU, and DU were mailed the survey instrument in the fall of 1986. Two weeks after the initial mailing, follow-up postcard reminders were sent to those who did not respond ... One hundred twelve TU members responded to the survey, for a return rate of 56%. Of these 110 were male ... Sixty-six usable responses were returned by DU members, for a return rate of 33%. Seven of the DU members were female ... One hundred three usable responses were returned by members of WTA, for a return rate of 51.5%. All WTA respondents were male." (Sivek & Hungerford, 1989/90, p. 36)

Sivek undertook four kinds of data analysis used by Sia (1985) to develop responses to his research questions. First, he used descriptive statistics to generate information which he would use to describe his samples. Second, he calculated correlation coefficients for the relationships amongst all predictor and dependent variables for each sample and for the total sample. Third, to respond to his first research question, he used zero-order regression analyses to identify and describe the extent to which each variable helped explain the variance in BIEA scores for each sample and for his total sample. Fourth, to respond to his second and third research questions, he used a maximum R-square improvement form of stepwise regression analysis (Sivek, 1989, pp. 70-73; Sivek & Hungerford, 1989/90, p. 37).

Table 5.

Results of Sivek's Analysis of the Correlation Between Each Predictor Variable and BIEA Scores for All Samples

Correlation of Predictor Variables to BIEA Scores

Predictors	WTA Sample (n=103)	DU Sample (n=66)	TU Sample (n=112)	Total Sample (n=281)
LES	.47 *	.28 *	.23 *	.34 *
EAKS/Knowledge	.44 *	.46 *	.20 *	.34 *
EAKS/Skill	.52 *	.49 *	.37 *	.45 *
ILOC	.33 *	.32 *	.13	.24 *
GLOC	.39 *	.27 *	.09	.25 *
PAQ/Gender Role	-.16	-.05	-.05	-.09
PTQ/Pollution	.32 *	.08	.16	.20 *
PTQ/Technology	-.05	.02	.04	-.01

Note: * = significant at p<.05

Table 6.

Results of Sivek's Zero-Order Regression Analyses for All Samples

R-Square Values from Zero-Order Regression Analyses

Predictors	WTA Sample (n=103)	DU Sample (n=66)	TU Sample (n=112)	Total Sample (n=281)
LES	.249 ***	.049	.078 **	.137 ***
EAKS/Knowledge	.202 ***	.1376 **	.028	.1075 ***
EAKS/Skill	.281 ***	.154 **	.111 **	.186 ***
ILOC	.123 ***	.115 **	.028	.078 ***
GLOC	.1765 ***	.0876 *	.011	.086 ***
PAQ/Gender Role	.05	.0015	.002	.0103
PTQ/Pollution	.098 **	.0046	.021	.0027 ***
PTQ/Technology	.003	.0003	.0026	.000

Note: Significance levels: * = p<.05; ** = p<.01; *** = p<.001

The results of Sivek's analysis of the strength of the relationship between each predictor variable and BIEA scores for each of his samples and for his total sample are presented in Table 5 (Sivek, 1989, pp. 102, 103, 105, and 107). His results indicate that level of environmental sensitivity, knowledge of action strategies and skill in using action strategies were significantly correlated to behavior for all samples (p<.05).

In addition, individual and group locus of control were significantly correlated for two of the three samples (WTA and DU), and for the total sample. The only other predictor variables significantly correlated to BIEA scores was belief in/attitude toward technology (i.e., for the WTA sample and the total sample). This general pattern of correlation is comparable to that reported by Sia (1985), though the strength of these relationships is consistently lower.

The results of Sivek's analysis of the zero-order contribution of each variable to an explanation of the variance in BIEA scores are summarized in Table 6 (Sivek, 1989, pp. 93, 95, 97, and 98). The results of Sivek's (1989) zero-order analyses indicate that the only significant predictor of BIEA scores for all samples was skill in using action strategies (EAKS/skill; p<.01).

Four other variables were found to serve as significant predictors for two of Sivek's three sample populations (p<.05): knowledge of action strategies (EAKS/ knowledge), level of environmental sensitivity (LES), and individual and group locus of control (ILOC & GLOC). The only other variable found to serve as a significant predictor of BIEA scores for any sample was belief in/attitude toward pollution (PTQ/Pollution) (p<.05). Three of these variables were also found by Sia to serve as significant zero-order predictors (i.e., LES, EAKS/skill, and EAKS/knowledge).

Table 7.

Results of Sivek's Stepwise Regression Analyses for the Total Sample (n=281)

Predictor Variables	R-Square Values	% Explained Variance	F Value	Probability
Perceived skill in using env. action strategies	.1860	18.60%	53.00	.0001 *
Level of env. sensitivity	.0847	27.07%	26.85	.0001 *
Perceived group locus of control	.0184	28.91%	5.95	.0154 *
Perceived indiv. locus of control	.0034	29.25%	1.08	.2990
Belief in/attitude toward pollution	.0032	29.57%	1.04	.3093
Perceived knowl. of env. action strategies	.0003	29.60%	0.10	.7519
Psychological sex role classification	.0001	29.61%	0.02	.8985
Belief in/attitude toward technology	.0000	29.61%	0.00	.9617

Note: Under the "Probability" column, * = significant at p<.05

The final set of results reported by Sivek (1989) of interest here are from his use of stepwise regression analysis. The results of the stepwise regression analysis for his entire sample are summarized in Table 7. These results may be compared to those reported for Sia's entire sample (see Table 4). This comparison provided two very important insights. First, the level of variance explained by the eight variable model was considerably higher for Sia's total sample than for Sivek's total sample (i.e., 52.15% vs. 29.61%, or a 22.54% difference). Nonetheless, both levels of explained variance are considerably higher than those reported elsewhere in the literature on REB. Second, regardless of these sample differences, the top two predictor variables of BIEA scores for the total samples in both studies were perceived skill in using action strategies (EAKS/skill) and level of environmental sensitivity (LES). On a combined basis, these two variables accounted for more than 90% of the variance explained by the eight variable prediction model (i.e., Sia's total sample: 47.46% of 52.15%; Sivek's total sample: 27.07% of 29.61%).

The results of the stepwise regression analyses for Sivek's organizational samples are summarized in Table 8 (Sivek, 1989, pp. 109, 110, 112, and 113). These results clearly indicate the following: (a) the level of explained variance in BIEA scores varied considerably across the three samples (i.e., ranging from 19.92% to 52.73%); (b) the respond-

Table 8.

Results from Sivek's Stepwise Regression Analyses for Each Sample Showing Variable Order, R-Square Values and Explained Variance

WTA Sample			DU Sample			TU Sample		
Var. Order	R-Sq. Value	% Expl. Variance	Var. Order	R-Sq. Value	% Expl. Variance	Var. Order	R-Sq. Value	% Expl. Variance
EAKS/ Skill	.281	28.10%	EAKS/ Skill	.1543	15.43%	EAKS/ Skill	.1109	11.09%
LES	.1936	47.46%	ILOC	.0534	20.77%	LES	.0404	15.13%
GLOC	.0277	50.23%	PAQ	.0242	23.19%	PTQ/ Poll.	.0165	16.78%
PAQ	.0161	51.84	PTQ/ Tech.	.0167	24.86%	EAKS/ Know.	.0212	18.90%
ILOC	.0063	52.47%	EAKS/ Know.	.0121	26.07%	ILOC	.0092	19.82%
PTQ/ Tech.	.0022	52.69%	LES	.0125	27.32%	PAQ	.0008	19.90%
EAKS/ Know.	.0002	52.71%	GLOC	.0048	27.80%	GLOC	.0002	19.92%
PTQ/ Poll.	.0002	52.73%	PTQ/ Poll.	.0019	27.99%	PTQ/ Tech.	.0000	19.92%

Table 9.

The Most Parsimonious Set of Variables Predicting Responsible Environmental Behavior for Sia's Sierra Club and Sivek's Wisconsin Trappers' Association, Ducks Unlimited and Trout Unlimited Samples

Percentage of Explained Variance

Predictor Variables	Sierra Club (n=105)	Wisconsin Trappers' Association (n=103)	Ducks Unlimited (n=66)	Trout Unlimited (n--112)
Perceived skill in using env. action strategies	30.15%	28.10%	15.43%	11.09%
Level of environmental sensitivity	9.85%	19.36%	-	4.04%
Perceived individual locus of control	-		5.34%	
Perceived group locus of control	-	2.77%	-	
% of Variance Explained by This Set of Variables	40.00%	50.23%	20.77%	15.13%
% of Variance Explained by All Eight Variables	42.56%	52.73%	27.99%	19.92%

ents' perceived level of skill in using action strategies was the strongest predictor of BIEA scores across all three samples; (c) the respondents' level of environmental sensitivity was the second strongest predictor in two of the three samples (i.e., WTA and TU); and (d) there was considerable variability in both the order and explanatory power of the remaining variables when compared across the three samples.

Sivek's (1989) final research question called for a comparison of the most parsimonious set of predictors for his samples from "consumptive resource use groups" and for Sia's (1985) Sierra Club sample. These results are reported in Table 9 (Sivek, 1989, p. 115; Sivek & Hungerford, 1989/90, p. 37), and indicate that four of Sia's (1985) and Sivek's (1989) predictors accounted for the majority of the explained variance in BIEA scores across these four sample groups. A more detailed analysis of the stepwise regression results for each of these samples reveals that no other variable accounted for more than 2.5% of the explained variance in more than one of these four samples.

Marcinkowski's (1989) Study of Predictors of REB

As with Sivek (1989), the underlying research problems which Marcinkowski (1989) perceived were related to Maloney and Ward's (1973) and Sia's (1985) comments regarding the "paucity" of research in the area of REB. More specifically, in a careful review of Sia's (1985) data, he found that Sia's eight variable model accounted for less and less of the explained variance in REB scores as one moved from his less active Elderhostel sample (R-square = 70.8%), to his more active Sierra Club sample (R-square = 42.5%), to his highly active sub-sample (R-square = 16.5%). Thus, his study was concerned with " ... the limitations in current knowledge about variables which contribute toward an explanation of the variance in levels of REB for environmentally active and involved members of conservation groups ... ." (emphasis added) (1989, p. 20).

In light of this, the purposes of Marcinkowski's study were:

> (1) to provide a replication for the portion of Sia's (1985) study of predictors of REB involving members of conservation organizations; (2) to identify the variables which contribute for a fuller explanation of the variance in the level of REB among active members of conservation organizations; and (3) to generate a model of the most parsimonious and powerful set of predictors of REB using data collected from active members of conservation organizations. (1989, pp. 20-21)

> [A]nother purpose of this study [was] to investigate the relative contribution of Hines' significant correlates in explaining the unaccounted for variance in the level of REB in the target population, thereby providing a test of her findings and conclusions. (1989, p. 22)

The following research questions were posed to guide this study:

> "1. To what degree can the statistical results of Sia's (1985) study of an explanation of the variance in REB (i.e., as reported by members of conservation organizations and by active individuals) using an eight variable predictor model be obtained in another study drawing from the same sample population and using the same variables?
>
> 2. Which variables add to an explanation of the variance in the level of REB reported by active members of conservation organizations beyond the degree of variance explained by the eight predictor variables drawn from Sia's (1985) study?
>
> 3. From those variables measured in this study, what is the most parsimonious set of variables which best explain the variance in the level of REB reported by active members of conservation organizations?" (Marcinkowski, 1989, p. 23)

For the first research question, Marcinkowski used nearly identical measures of the eight predictor variables and one-year profile of REB which had been used by Sia (1985) and Sivek (1989), thereby allowing comparisons to be made across these studies. With respect to the second and third questions, he selected and used several kinds of variable measures:

> (a) additional measures for some of Sia's eight selected predictor variables (i.e., environmental sensitivity, individual and group locus of control, knowledge of environmental action);
>
> (b) measures for variables found by Hines to significantly correlate to REB (e.g., commitment, personal responsibility, other salient dimensions of environmental attitudes) ; and
>
> (c) measures of additional variables with some evidence of relationship to REB (e.g., environmental concern, optimism/pessimism, environmental values)

Further, as was done by both Sia and Sivek, socio-demographic data were collected to describe the study samples. However, neither Sia nor Sivek included these variables in their analyses of predictor variables. Since research summaries by Buttel (1976), Van Liere and Dunlap (1980, 1981) and Hines (1985) indicated there was evidence of some relationship between socio-demographic variables and REB, Marcinkowski included these variables in his analyses of predictors. Finally, several variables not included in the analysis of predictors were measured and reported separately (e.g., sources of environmental information, a ranking of issues, beliefs about environmental action strategies).

The samples included in this study were "... members of the Southern Illinois Chapter of the Illinois Audubon Society (n=147), or the Shawnee Chapter of the Sierra Club (n=194), or of both" (Marcinkowski, 1989, p. 368).

Data were collected from these samples and from sub-samples in a three phases over the period of a year. These phases were:

- an initial survey of all members, containing measures of REB and environmental sensitivity. "During the first phase of this study, approximately 36% of the members of these chapters (i.e.,Illinois Audubon: n=53; Sierra Club: n=66) returned completed and usable responses" (Marcinkowski, 1989, p. 368);

Table 10.

Results of Marcinkowski's Quartiling of the Sample Using REB Scores from the Initial Phase of this Study (n=119)

	BIEA Score Quartiles		
Samples	1st Quartile (Low)	2nd & 3rd Quartiles (Medium)	4th Quartile (High)
BIEA Range	0 - 19	20 - 49	50 - 119
Total Sample	n=23 (19%)	n=71 (60%)	n=25 (21%)
* SC Sample	n=14 (21%)	n=39 (59%)	n=13 (20%)
* IA Sample	n= 9 (17%)	n=32 (60%)	n=12 (23%)

* Under Samples, SC = Sierra Club, and IA = Illinois Audubon

- the piloting of an in-depth data collection procedure, consisting of two surveys and an interview, using respondents to the initial survey who were moderately active (i.e., in the third quartile, with REB scores of 40-49) and moderately-to-highly sensitive (n=12); and

- the use of a slightly revised version of this in-depth data collection procedure with respondents to the initial survey who were highly active (i.e., in the fourth quartile, with REB scores of 50 or more) . The last of these surveys included a "one-year later" repeated measure of REB. Of the 25 respondents in the fourth quartile, 19 provided usable data.

The procedures used to segment respondents into groups evidencing low, moderate and high levels of activity were identical to the quartiling procedures used by Sia (1985) (Table 10; see Table 2).

As a check on the reliability of the REB data, an analysis of variance was run to determine if there were any statistically significant differences between sets of REB scores obtained from the highly active sample in the first and third phases of this study (n=19). "As expected, no significant difference (F 18,17 = 0.02, p<.8904) was detected" (Marcinkowski, 1989, p. 374). Additional validity and reliability estimates for REB data and for measures of independent variables were reported from prior research (Marcinkowski, 1989, pp. 234-277), generated through the use of response checks during interviews, and determined by calculating the consistency amongst and/or correlations between multiple measures of predictor variables (Marcinkowski, 1989, pp. 224-227, 277-361).

The resulting data were analyzed in five ways. First, all variables were analyzed descriptively to permit characterization of the sample, sub-samples and data set. Second, for the first research question, data on the eight variables taken from Sia's study were analyzed in the same ways as Sia had analyzed his data (i.e., quartiling of REB scores, correlations amongst independent and dependent variables, zero-order and stepwise regression analyses) . Third, for the second research question, data for additional measures of the variables taken from Sia's study were substituted into the eight variable model, individually and in various combinations, using zero-order and stepwise regression analyses. Fourth, for the second research question, all additional independent variables were analyzed using the same procedures used to analyzed the eight predictor variables taken from Sia's study. For additional variables found to correlate with REB scores (p<.10), each was assessed for its strength as a predictor by adding it as a ninth variable to Sia's eight variable model, and running each nine-variable model through stepwise regression analysis. Finally, for the third research question, all variables found to significantly correlate with and predict REB scores were then combined into one list. Using a series of stepwise regression analyses, this list of variables was narrowed down to a small set which maximized statistical prediction (i.e., R-square values).

Table 11.

Results of Marcinkowski's and Sia's Analysis of the Correlation Between Each Predictor Variable and REB Scores for Select Samples

	Samples					
	Marcinkowski's Sample (n=31)			Sia's Sierra Club Sample (n=105)		
Variables	Order	r	prob.	Order	r	prob.
In. Locus of Control	1	.458	.009 *	4	.33	*
Knowledge of Action	2	.439	.013 *	2	.48	*
Gr. Locus of Control	3	.362	.045 *	5	.23	*
Skill Using Action	4	.270	.140	1	.55	*
Attitude/Technology	5	- .198	.284	7	- .09	
Environ. Sensitivity	6	.098	.597	3	.47	*
Psych. Gender Role	7	.077	.678	6	-.22	*
Attitude/Pollution	8	.045	.809	7	-.09	

Note: Under the "prob." column, * = significant at p <.05

The results for the first research questions were generated using Marcinkowski's sample (n=31), and then comparing these to results for Sia's (1985) Sierra Club sample (n=105). The results of a t-test comparison indicated that these two samples' scores differed significantly (p<.05) on three of the five REB subscales (i.e., ecomanagement, persuasion, consumer action) (Marcinkowski, 1989, p. 424). The results of the correlation of the eight variables to REB scores for these two samples are summarized in Table 11 (Marcinkowski, 1989, p. 433). While some of Sia's probability data are missing, this comparison also indicated there were observable differences between these two samples, even though both were drawn from the membership of Midwestern chapters of national conservation groups. When these r values were transformed in z scores and compared using a z test, the two samples differed significantly on the relationships between environmental sensitivity and REB scores, and between skill in using action strategies and REB scores (Marcinkowski, 1989, p. 430).

These differences in correlation values for the relationship of the eight variables to REB scores for samples from Marcinkowski's and Sia's studies were reflected in results of both zero-order and stepwise regression analyses for these samples (Marcinkowski, 1989, pp. 437 and 442; Sia, 1985, pp. 127 and 142). The results of the stepwise regression analyses for these two samples are presented in Table 12 (next page) . A comparison of these two sets of results can be summarized as follows:

- the total percent of explained variance accounted for by the same eight variable model for these two samples both exceeded 40%, and were within 3% of one another;
- three of the top four predictors for both samples were knowledge of and skill in using action strategies, and attitudes toward technology. For these variables, both their order and percent contribution to the explained variance differed for the two samples;
- for both samples, the next three predictor variables were psychological gender role, group locus of control, and attitudes toward pollution. For these variables, both their order and their percent contribution to the explained variance were nearly identical for the two samples;
- there were noticeable differences between the two samples on the ordering and percent contribution to the explained

Table 12.

Results of Stepwise Regression Analyses for Marcinkowski's Sample and Sia's Sierra Club Sample

Marcinkowski's Sample (n=31)					Sia's Sierra Club Sample (n=105)				
Variable Order	R-square values	% Expl. Variance	F	p	Variable Order	R-square values	% Expl. Variance	F	p
Knowledge of Action	.193	19.3%	5.35	.03	Skill Using Action	.301	30.1%	44.46	.0001
Attitude/ Technology	.117	31.0%	4.63	.042	Environment. Sensitivity	.098	40.0%	16.76	.0001
Ind. Locus of Control	.078	38.3%	2.43	.133	Knowledge of Action	.011	41.1%	1.91	.170
Skill Using Action	.053	44.1%	2.13	.158	Attitudes/ Technology	.003	41.4%	0.62	.433
Psychologic. Gender Role	.005	44.6%	0.26	.613	Psychologic. Gender Role	.004	41.9%	0.79	.376
Gr. Locus of Control	.006	45.2%	0.11	.742	Gr. Locus of Control	.002	42.1%	0.38	.539
Attitude/ Pollution	.002	45.4%	0.09	.763	Attitudes/ Pollution	.002	42.3%	0.36	.548
Enironment. Sensitivity	.001	45.5%	0.03	.867	Ind. Locus of Control	.001	42.5%	0.29	.594
Full Model		45.5%			Full Model		42.5%		

variance for the variables environmental sensitivity and locus of control.

Marcinkowski 's second research question focused on identifying those variables which would add to the total percent of explained variance accounted for by the eight predictors in Sia's model. When data from each of the second measures of Sia's variables were substituted into an eight variable stepwise regression equation, it was found that two of these added significantly ($p<.05$) to the percent of explained variance: (a) group locus of control: total % of explained variance = 68.6%; and (b) knowledge of action: total % of explained variance = 47.9% (Marcinkowski, 1989, p. 450). When data from all four second measures were substituted into the eight variable stepwise regression equation at the same time, it was found that these two variables (a and b, above) were ordered first and second, together accounting for 71.4% of the explained variance in REB scores. This new eight variable model now accounted for 75.4% of the explained variance in REB scores (Marcinkowski, 1989, p. 453).

Of equal, if not greater, importance to this study was the identification of other significant correlates and predictors of REB, such as those identified by Hines (1985). The results of the first step in these analyses indicated that fourteen (14) variables were found to significantly correlate with REB scores at $p<.10$ (Marcinkowski, 1989, p. 456; see Table 13). The correlational results for most of these additional variables were largely expected on the basis of prior theory and research (Fishbein & Ajzen, 1975; Van Liere & Dunlap, 1980; Hines, 1985).

Table 13.

Results of Marcinkowski's Stepwise Regression Analyses when Each Significant Correlate is Added as an Ninth Variable (n=31)

Ninth Variables	R-square contribution	% Expl. Variance	F	Prob.
* Attitudes/Economics	+.1766	63.12%	10.08	.004
* Political View	+.0786	53.41%	3.55	.073
* Yrears at Current Residence	+.0758	53.13%	3.40	.079
* Age	+.0623	51.78%	2.71	.114
* Group Efficacy	+.0507	50.62%	2.16	.156
* Nunber of Conservation Group Memberships	+.0425	49.80%	1.78	.196
* Fulfilled Commitments	+.03	48.55%	1.23	.280
* Individual Efficacy	+.0261	48.16%	1.06	.314
* Knowledge of Problems and Issues	+.0224	47.79%	0.90	.352
* Responsibility to Self for Solutions	+.0202	47.57%	0.81	.371
* Willingness to Make Commitments	+.0178	47.33%	0.71	.408
* Citizens' Efficacy	+.0085	46.40%	0.33	.569
* Personal Commitment	+.0048	46.03%	0.19	.670
* Committed Time & Energy	+.0034	45.89%	0.13	.718

Each of these fourteen variables was added as a ninth variable to the eight variables in Sia's 5 model for the purpose of determining which, if any, would serve as additional, significant predictors of REB scores (Marcinkowski, 1989, p. 462). The results of these analyses indicated that while each of these fourteen contributed to total percent of explained variance, only one did so at a statistically significant level ($p<.05$): attitudes toward economics. This dimension of attitude was measured using six semantic differential scales similar to those used by Borden (1979a), Sia (1985) and others to measure attitudes toward technology and toward pollution. It also should be noted that the three variables which made the next greatest contributions to the percent of explained variance in REB scores were socio-demographic variables (i.e., political view, measured on a conservative/liberal scale; years living at current residence; and age, measured in nearest whole years).

The third research question under investigation focused upon the development of the most parsimonious set of variables which best explain the variance in the level of REB reported by active members of conservation organizations. From zero-order and stepwise regression analyses, Marcinkowski reported results for best single variable, two variable, five variable and eight variable prediction models (1989, p. 467). These results are summarized in Table 14. Responses on the attitude toward economics measure reflected an awareness that economic conditions both caused and were used to help solve environmental problems. Further, of the 14 terminal values in the value measure, other-worldly salvation had the lowest mean rating, with respondents rating it either high or low (i.e., a bimodal distribution).

Further Comparison of Sia's, Sivek's, and Marcinkowski's Results

A careful review of the variables included in Marcinkowski's "most powerful" models of predictor variable (1989; see Table 14) to those reported by Sia (1985; see Tables 4 and 12) and those reported by Sivek (1989; see Tables 7 through 9) will complete a comparison among these three studies and will help generate several important conclusions. Across these three studies, five variables were found to significantly correlate with and predict REB scores: (1 & 2) individual and group locus of control; (3 & 4) knowledge of and skill

Table 14.

Results of Marcinkowski's Stepwise Regression Analyses Determining the Most Powerful Models of Predictors of REB (n=31)

Variable Models	R-Square Values	% Explained Variance	F Value	Prob.
Best Single Variable Model				
* Knowledge of Action	.398	39.8%	19.18	.0001
Best Two Variable Model				
* Ind. Locus of Control	.210	21.0%	19.70	.0001
* Attitudes/Economics	.326	53.6%	23.26	.0001
Best Five Variable Model				
* Ind. Locus of Control	.210	21.0%	9.64	.0001
* Attitudes/Economics	.326	53.6%	22.06	.0001
* Age	.089	62.5%	5.71	.024
* the value Salvation	.044	66.9%	4.41	.046
* Individual Efficacy	.036	70.5%	3.03	.093
Best Eight Variable Model				
* Ind. Locus of Control	.210	21.0%	10.69	.0003
* Attitudes/Economics	.326	53.6%	20.06	.0002
* Age	.089	62.5%	2.98	.098
* the value Salvation	.044	66.9%	3.32	.082
* Individual Efficacy	.036	70.5%	2.58	.122
* Political View	.011	71.6%	2.68	.116
* Group Locus of Control	.024	74.0%	3.37	.079
* Knowledge of Action	.017	75.7%	1.53	.228

in using action strategies; and (5) environmental sensitivity. Other variables, such as attitudes toward technology and economics, were also found to correlate with and predict REB scores, though in a less consistent manner and to a lesser degree.

Individual and group locus of control were two of the four variables found by Sia and by Sivek to be amongst their strongest predictors of REB (Table 9) were also included in Marcinkowski's list of strongest predictors of REB (Table 14). The variable individual efficacy, thought by Hines (1985) and others to be very closely related to individual locus of control, also appears in Marcinkowski's five-variable model, further highlighting the importance of these variables.

The variable reported by Sia (1985) and Sivek (1989) to serve as the strongest predictor of REB was *skill in using action* strategies. At the same time, both researchers found knowledge of action strategies to be a relatively weak predictor of REB for all of their samples (Tables 4, 7-9, 12). For example, it was entered fourth into the stepwise regression equation for Sivek's Trout Unlimited sample (Table 8), and third into the stepwise regression equations for Sia's total sample (Table 4) and Sierra Club sample (Table 12). In all cases, knowledge of action strategies accounted for less than 3% of the explained variance in REB scores for the samples and sub-samples in these two studies.

On the other hand, Marcinkowski (1989) reported that the strongest single predictor of REB was knowledge of action strategies (Table 14). It alone accounted for nearly 40% of the variance in REB scores for his sample (Table 14). Further, Marcinkowski reported that skill in using action strategies contributed a little more than 5% of the explained variance in REB scores for his sample.

There is an explanation for the apparent disparity in findings on the knowledge of action and skill in using action variables across these studies. The correlations between these two variables for Sia's (1985), Sivek's (1989) samples and sub-samples, and Marcinkowski's (1989) sample were significant in all cases (i.e., ranging from a low of r=.72 for Sivek's Trout Unlimited sample, to a high of r=.87 for Sivek's Wisconsin Trapper's Assoc. sample). Further, results of zero-order regression analyses indicated that both variables were significant predictors of REB scores when considered individually (Sia, et al., 1985/86; see Table 6). Since knowledge of and skill in using action are highly correlated to each other and to REB in these studies, it is highly likely that they would share in common a substantial portion of the explained variance in REB scores. Consequently, only one of these variables was likely to show up as a significant predictor for any of these studies' samples or sub-sample (Table 15). In Sia's and Sivek's studies, skill in using action was found to be the strongest predictor, while in Marcinkowski's study, knowledge of action was.

Finally, the second variables reported by Sia (1985) and Sivek (1989) to serve as a strong predictor of REB, environmental sensitivity (Table 9), was not included amongst the strongest predictors of REB for Marcinkowski's (1989) sample (Table 14). In Marcinkowski's study, environmental sensitivity was found to contribute one-tenth of one percent (.1%) to the explained variance for Marcinkowski's sample (Table 12). A comparison of REB and sensitivity scores for Sia's Sierra Club sample to those for Marcinkowski's sample revealed: "an increase in variable mean scores, a decrease in correlation to REB, [and] a shift in the magnitude of variable R-square contributions" (Marcinkowski, 1989, p. 493). From these data he inferred that the insignificance

Table 15.

Summary of Stepwise Regression Results Regarding the Relative Ordering and Contribution to Explained Variance in REB for Knowledge of Action and Skill in Using Action

		Stepwise Regression Results			
		Know. of Action		Skill in Action	
Study	Samples	Entry Order	R-square Value	Entry Order	R-square Value
Sia (1985)	Total	3rd	1.78%	1st	34.54%
	Sierra Club	3rd	1.1%	1st	30.1%
Sivek (1989)	Total	6th	.03%	1st	18.6%
	Wisconsin Trapper's Association	7th	.02%	1st	28.1%
	Ducks Unlimited	5th	1.21%	1st	15.43%
	Trout Unlimited	4th	2.12%	1st	11.09%
Marcinkowski (1989)	Total	1st	19.3%	4th	5.3%

of environmental sensitivity as a predictor in his study was due to both higher sensitivity scores and substantially higher behavior scores. It was later hypothesized that environmental sensitivity was a "threshold" or "entry" variable; i.e., one which would differentiate less active from more active individuals, but which would not be as useful in differentiating amongst more active individuals (Hungerford & Volk, 1990, p. 11).

Discussion of the Implications and Impacts of These Studies

In 1997, nearly ten years since the studies by Sivek and Marcinkowski, it is apparent that the extent to which these studies held implications for the field of EE was a matter of perception. Each of these three researchers presented their views on the meaning of their studies for the field in the implications and recommendations sections of Chapter 5 in their respective dissertations (Sia, 1985; Sivek, 1989; Marcinkowski, 1989). These studies, along with their implications and recommendations, again were presented to the field at-large through articles in *The Journal of Environmental Education* (Sia, et al., 1985/86; Sivek & Hungerford, 1989/90). All three studies, along with studies by Hines (1985), Ramsey (1979) and others, were summarized by Hungerford (1988) in his attempt to present a cohesive synthesis of the results of and the meaning of a set of studies pertaining to REB from the 1980s. Hungerford's initial synthesis was subsequently revised and expanded for presentation at a Unesco Conference in Thailand, with the help of Volk and others (Hungerford & Volk, 1990).

These and other publications reflect what their authors view as an evolution in thought about the role of REB within the field of EE, about these and other research studies, about practice in various sectors of the field (e.g., formal, non-formal, teacher education), and about the kinds of relationships which can and should exist amongst these things. As this evolving body of work and thought has become more accessible to professionals and researchers in the field, it has been met with mixed reactions. Some welcomed it (e.g., Simmons, 1991, 1995; Wilke, 1995), others criticized it (e.g., Robottom & Hart, 1995) and, I suspect, many remain unaware of it or have largely ignored it for one reason or another.

From my point of view, the research implications of these studies are far reaching. There remains an ongoing need to: (a) replicate these studies as a check on the confidence in reported results; (b) evaluate and refine data collection techniques on predictor variables (e.g., self vs. other reported data); (c) continue to investigate unexplained variance within their sample populations; (d) expand this vein of research by involving broader sample populations (e.g., K-12 students, teachers, the general public); and (e) continue to explore significant predictors in educational settings using descriptive and experimental methods. These kinds of recommendations were offered in the three dissertations, and later were included amongst significant national-level EE research needs and priorities in the U.S. (Wilke, 1990; Saunders, Hungerford, & Volk, 1992). Several of the research needs and priorities from this list served as focal points for the National Environmental Literacy Assessment (NELA) Project (Wilke, 1995).

These and other publications reflect what their authors view as an evolution in thought about the role of REB within the field of EE, about these and other research studies, about practice in various sectors of the field (e.g., formal, non-formal, teacher education), and about the kinds of relationships which can and should exist amongst these things. As this evolving body of work and thought has become more accessible to professionals and researchers in the field, it has been met with mixed reactions. Some welcomed it (e.g., Simmons, 1991, 1995; Wilke, 1995), others criticized it (e.g., Robottom & Hart, 1995) and, I suspect, many remain unaware of it or have largely ignored it for one reason or another.

One example of the research recommended above in (d) involved a secondary analysis of data from the NELA Project's 1995 Spring Field Test. Using Secondary School Environmental Literacy Instrument (SSELI) data obtained from a sample of 436 secondary students in five states, Lierman (1996) conducted a secondary analysis of correlates and predictors of REB amongst secondary students. She found that skill in using action, knowledge of action, willingness to act, environmental sensitivity, personal responsibility and locus of control (i.e., individual and group locus, combined) were the strongest individual (zero-order) predictors of these students' REB scores (p. 34). It is noteworthy that this list contains the strongest predictors from the studies by Sia (1985), Sivek (1989) and Marcinkowski (1989), and the strongest correlates from Hines' meta-analysis (1985). Given the nature and size of this study's sample, her results are encouraging. It is equally noteworthy that, as expected, the level of explained variance reported by Lierman (1996) is noticeably below that reported by Sia (1985), Sivek (1989) and Marcinkowski (1989) for conservation-oriented adult samples.

A second example of this kind of recommended research was recently completed and reported by Hsu (1997). Using the results of research reported by Hines (1985), the framework presented by Hungerford and Volk (1990), and both the framework for environmental literacy and instruments developed for the NELA project (Wilke, 1995), Hsu assessed the level of literacy and predictors of REB amongst samples of rural and urban teachers in Taiwan (n=226). He reported that perceived knowledge of action, intention to act, and perceived skill in using action were his only significant predictors (p<.05), with these three variables accounting for 32.36% of the variance in REB scores. He also found that the three next strongest predictor variables were perceived knowledge of environmental problems and issues, environmental sensitivity and locus of control (p. 150). As in Lierman's (1996) analysis, all five of the strongest predictors identified by Sia (1985), Sivek (1989) and Marcinkowski (1989) were found to be amongst Hsu's strongest predictors of REB for teachers. Further, as might be expected, the level of explained variance (33.5%) is higher than that reported by Lierman (1996) for secondary students, but lower than reported for adult members of conservation groups.

The kinds of research reported and recommended by Sia, Sivek and Marcinkowski are of particular value when results are summarized and compared with an eye toward their implications for EE practice.

The kinds of research reported and recommended by Sia, Sivek and Marcinkowski are of particular value when results are summarized and compared with an eye toward their implications for EE practice. On the basis of these three dissertation studies, the kinds of practical educational questions one could ask include, but are not limited to:

- How did the researchers define (measure) knowledge of and skill in using action, environmental sensitivity, and individual and group locus of control?
- Given these definitions, which of these variables, or which aspects of these variables, can be addressed in formal and in non-formal education settings?
- Of those that can be addressed, at which age/grade level(s) is it best to address each, and what educationally sound practices exist to address each?
- How can teachers be prepared to use appropriate curricular, instructional and assessment practices related to these variables?
- How can teachers in a particular district or school be encouraged and supported to work together to plan and implement an EE scope and sequence which would include attention to these five variables?

The researchers involved in these studies have stated that all five variables can and should be addressed in formal and non-formal settings (Sia, et al, 1985/86, pp. 38-39; Sivek, 1989, pp. 128-133; Marcinkowski, 1989, 550-558). For example, a series of experimental-type research studies have demonstrated over time that knowledge of and skill in using action strategies can be taught effectively to learners above the fifth grade level in formal school settings (Klingler, 1980; Ramsey, 1979, 1993; Ramsey & Hungerford, 1989; Culen, 1994) and, to a lesser extent, non-formal settings (Jordan, Hungerford & Tomera, 1986). Many of these studies also have found that when students are exposed to these kinds of teaching and learning experiences (i.e., learning issue and action skills), there was a positive effect on individual and group locus of control.

Since these studies involved educational materials and programs designed to address problems, issues and actions, they neither were intended to nor were found to influence environmental sensitivity (Ramsey & Hungerford, 1989; Ramsey, 1993). Environmental sensitivity is perhaps the most difficult of the significant predictor variables to address through formal education practices, since this would involve exposing learners to pristine natural environments on a direct basis over time, as well as on an indirect basis through role models, films, books, and the like. While these kinds of experiences can be provided in some schools, teachers often encounter needs and/or barriers when attempting to do so (Simmons, 1993). Often, these kinds of experiences can be easily provided for formal and non-formal groups in non-formal settings (e.g., center and camp programs). What remains most difficult about environmental sensitivity is its assessment (e.g., the method and timing of data collection, the sensitivity of measures and/or analyses). From post hoc research with adults, it is believed that this "sense of empathy" toward the natural world develops over time (Tanner, 1980; Peterson, 1982), though little is currently known about its development over time, in part due to these assessment difficulties (Sward & Marcinkowski, in review).

Some readers may be interested in the educational implications of these five predictor variables for pre- and in-service teacher education. Research by Peyton (1978) indicates that it may be appropriate, if not necessary, to assess and address teachers' own background related to these five variables (e.g., their own sensitivity-related experiences or experience using action skills) during early phases of teacher education programs. This may be done prior to or as a part of methods instruction related to these variables. Efforts have been made to address these variables when designing strategies and guidelines for infusing EE into elementary and middle level pre-service programs (Hungerford, Volk, Dixon, Marcinkowski, & Sia, 1988; Marcikowski, Volk, & Hungerford, 1990). However, given the limited success in actually infusing EE content and methods into pre-service programs in colleges and universities within the U.S. (McKeown-Ice, 1995), there is little information about efforts to address these variables or about the effects and effectiveness of such programs. This too is in need of serious attention in the field of EE.

The final question posed on the previous page is equally important: "How can teachers come together to plan and implement an EE scope and sequence for their school which includes these five variables?". To date, little has been published about EE in U.S. schools which begins to address to this question (e.g., Lieberman & Hoody, 1997). On the basis of anecdotal evidence and experience, there appear a number of related, often interlocking, factors which can influence teachers' efforts and success here (e.g., teachers' backgrounds and leadership skills, administrative and outside professional support, access to fiscal and material resources). Beyond brief case studies which identify and describe some of these efforts, there is little information about how well designed EE programs started and evolved, how they work, and how well they address and achieve objectives related to these predictor variables.

In addition to these studies holding implications for research and for practice in EE, they hold implications for EE theory. Sound theory is grounded in prior research, accommodates variations in practice, and should be adjusted to accommodate gains in knowledge and major influences on practice. Until the early 1980s, theory pertaining to REB was problematic. In the early 1980s, Sia (1985) found an apparent lack of theory to guide research and practice as it related to behavior-related goals and objectives in EE. In the course of her meta-analysis, Hines (1985) found an abundance of differing, sometimes competing, and often irreconcilable theories (e.g., theories relating to specific behaviors such as a particular vote, to kinds of behavior such as recycling, and to categories of behavior such as consumer action).

. . . there is little information about how well designed EE programs started and evolved, how they work, and how well they address and achieve objectives related to these predictor variables.

It is reasonable to view these dissertation studies as contributing to the evolution of research-based theory in EE, theory which sought a practical middle ground between Sia's "lack" and Hines' "irreconcilable abundance". It is significant that these studies began by selecting potential predictor variables for behavior from a model of environmental literacy (Hungerford & Tomera, 1985), sought to both test and refine that model, and did so by considering the widest and therefore most generalizable range of REBs. The results of these and other studies did lead to refinements in Hungerford and Tomera's model (e.g., Marcinkowski, 1989, p. 123), and eventually to a reformulation of it (Hungerford & Volk, 1990, p. 11). Further, the results of these studies were influential in the formulation of the framework (model) of environmental literacy for the NELA Project (Wilke, 1995). The five strongest predictor variables, along with actual REB, were included in that framework (e.g., under the heading "Additional Determinants of Environmentally Responsible Behavior") (1995, p. 5). Finally, the results of these studies were addressed in the framework underlying NAAEE's ongoing "Guidelines for Excellence" Project (Simmons, 1995). The chart used to compare differing sets of goals, objectives, guidelines and frameworks included "Determinants of Env. Responsible Behavior" (pp. 53-58). These kinds of apparent influences will only be of value to the field to the extent that the resulting "models" or "theories", do, by design, actually influence educational practices in the field.

As outlined in this closing discussion, limitations in what is known and apparent barriers to putting what is known into practice remain as some of the most vital challenges which lie before us as a field, a community of researchers and practitioners.

Editors' Note:

If one were to succinctly summarize this reading and what it means to the field of EE, it might appear as follows: Dr. Marcinkowski has synthesized a number of very important and closely related studies which investigated the precursors to REB (Responsible Environmental Behavior). In so doing, he has been able to demonstrate that the traditional mode of thinking in the field regarding the initiation of REB is terribly faulty. This traditional mode of thinking held that, if an educator can instill knowledge of environmental problems/issues, this will impact the attitudes of the learners and appropriate citizenship behavior will follow. We know now that this is not the case for large numbers of learners over substantial amounts of time. Instead, we now know that the major precursors to REB appear to lie in a meld of five important variables. These variables are: (1) environmental sensitivity; (2) knowledge of citizenship action strategies; (3) skill in using citizenship action strategies; (4) individual locus of control; and (5) group locus of control.

The implications of these research findings and Dr. Marcinkowski's synthesis are very clear. Environmental educators must begin to focus on these variables during instruction and in the design of instructional materials. Only in this way can we anticipate having an impact on large numbers of learners over long periods of time. As Hungerford and Volk stated a number of years ago: *The research is very clear on the matter. Citizenship behavior can be developed through environmental education. The strategies are known. The tools are available. The challenge lies in a willingness to do things differently than we have in the past.*

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Changing Learner Behavior through Environmental Education

Harold R. Hungerford and Trudi L. Volk

Editor's Note: This is an article on research into responsible environmental behavior that has become something of a classic in the field of environmental education. In this reading Drs. Hungerford and Volk probe in some depth the research that has led to a refined model illustrating the variables which seem to be associated with citizenship behavior in EE. Having displayed and discussed this model of major and minor variables involved in environmental citizenship behavior, they identify a number of critical educational components in any instructional program which have been shown to impact on learners' citizenship behavior. They then present two different instructional models which have been shown effective in promoting responsible citizen behavior. This is followed by three major concerns held by the authors for the field which are related to the subject of the paper itself.

Editor's note [as published with the original article]:

In March 1990, several United Nations (UN) agencies jointly sponsored a worldwide conference on education entitled "World Conference on Education for All - Meeting Basic Learning Needs" as part of the UN proclamation of 1990 as the International Year of Literacy. The primary sponsoring agencies were UNESCO, UNDP, UNICEF; and the World Bank. The conference was held in Jomtien, Thailand. All UNESCO member nations were invited to send ministers of education and other representatives. In response, over 100 nations sent delegations, totaling more than 1,500 delegates. These included four heads of state, as well as educational experts and teams from a host of non-governmental organizations.

One of the conference's educational roundtables was entitled "Environmental Education: A Component of Sustainable Development." A number of professionals from different countries were invited to serve on this panel and to prepare papers on selected topics. Dr. Colin Power, UNESCO'S assistant director-general for education, served as the panel moderator. Panelists included: Dr. Michael Atchia, chief, Environmental Education and Training Unit, UNEP, Nairobi, Kenya; Dr. Thilla Chellia, Faculty of Education, University of Malaya, Kuala Lampur, Malaysia; Ms. Chodchoy Sophonpanvich, president, Thai Environment and Community Development Association; and Drs. Harold Hungerford and Trudi Volk, Faculty of Education, Southern Illinois University at Carbondale. The papers prepared and topics addressed by the panel were: environmental education; changing learner behavior; introducing environmental education into elementary schools; and the role of non-governmental organizations in environmental education. The paper prepared and delivered by Drs. Hungerford and Volk is published here in its entirety. The views expressed in this paper are those of the authors only and do not necessarily represent those of the sponsoring organizations.

The ultimate *aim* of education is shaping human behavior. Societies throughout the world establish educational systems in order to develop citizens who will behave in desirable ways. In education, some of the desired behaviors are sharply defined, e.g., skills useful in reading and mathematics. Other desired behaviors are more complex, e.g., successful consumerism, productive employment, responsible citizenship. It is on one of these latter behaviors, responsible citizenship, that this paper is focused. Specifically, this paper will address the effectiveness of environmental education for promoting responsible citizenship behavior.

How might responsible environmental behavior be operationalized? In order to answer this question, we must look to the objectives for environmental education (EE) as defined by the 1977 Tbilisi Intergovernmental Conference on Environmental Education. These objectives, which can be

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found in the Tbilisi conference declaration (1978), are as follows:

Awareness - to help social groups and individuals acquire an awareness and sensitivity to the total environment and its allied problems [and/or issues]

Sensitivity - to help social groups and individuals gain a variety of experiences in, and acquire a basic understanding of, the environment and its associated problems [and/or issues]

Attitudes - to help social groups and individuals acquire a set of values and feelings of concern for the environment and motivation for actively participating in environmental improvement and protection

Skills - to help social groups and individuals acquire skills for identifying and solving environmental problems [and/or issues]

Participation - to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems [and/or issues]

By using these objectives, we might define an environmentally responsible citizen as one who has (1) an awareness and sensitivity to the total environment and its allied problems [and/or issues], (2) a basic understanding of the environment and its allied problems [and/or issues], (3) feelings of concern for the environment and motivation for actively participating in environmental improvement and protection, (4) skills for identifying and solving environmental problems [and/or issues], and (5) active involvement at all levels in working toward resolution of environmental problems [and/or issues].

The educational task, which is implied by the Tbilisi objectives, is an ambitious one. The citizenship behavior that they describe demands an educational thrust that goes beyond "basic" education in its traditional sense. Instead, we are faced with a set of objectives that paint a broad picture of behavior encompassing not only knowledge, attitudes, and skills, but also active participation in society. The challenge for educators is to translate the Tbilisi objectives into instructional reality. And, since the objectives focus on responsible behavior, it would be appropriate and helpful to consult traditional thinking about behavior as well as recent research into environmental behavior.

Traditional Thinking Versus Research Findings

The traditional thinking in the field of environmental education has been that we can change behavior by making human beings more knowledgeable about the environment and its associated issues. This thinking has largely been linked to the assumption that, if we make human beings more knowledgeable, they will, in turn, become more aware of the environment and its problems and, thus, be more motivated to act toward the environment in more responsible ways. Other traditional thinking has linked knowledge to attitudes and attitudes to behavior. An early and widely accepted model for EE has been described in the following manner: "[I]ncreased knowledge leads to favorable attitudes . . . which in turn lead to action promoting better environmental quality" (Ramsey and Rickson 1977). Both of these models are, in fact, very similar and can be illustrated as shown in Figure 1.

Research into environmental behavior, unfortunately, does not bear out the validity of these linear models for changing behavior. Numerous researchers have investigated a variety of variables hypothesized to be associated with responsible environmental behavior. Many studies have looked at only one variable at a time, and numerous of these have been correlational studies that cannot claim "cause and effect" relationships.

This is not to say that the research in the field has not been productive. Indeed, it has. However, to present a detailed survey of the research literature here would be an enormous task and detract from the major thrust of this document. Let us, at least

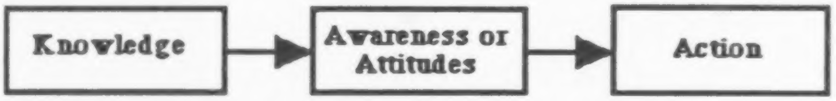

Figure 1. [Theorized] Behavioral Change System

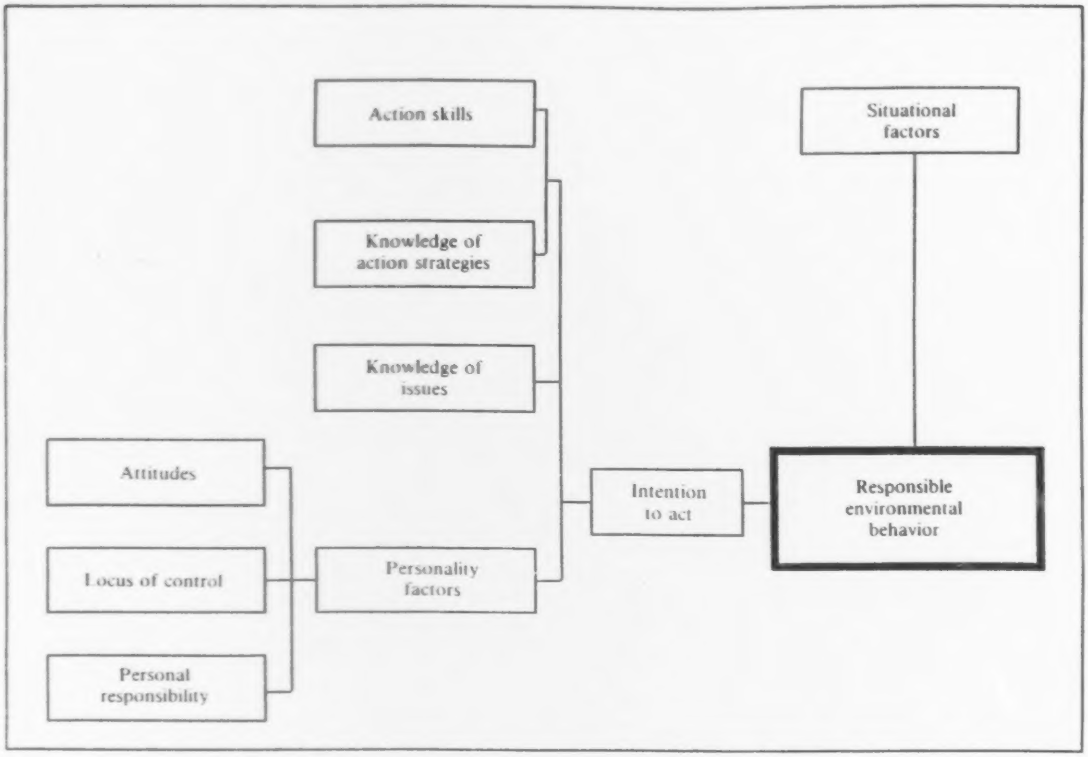

Figure 2. The Hines Model of Responsible Environmental Behavior
(Adapted from Hines et. al. (1986/87

initially, transcend the bulk of that research by focusing our attention on one particular study which synthesizes the work that preceded it.

In 1986-87, Hines et al. published an important meta-analysis of the behavior research literature in EE. The researchers analyzed 128 studies

> ... which had been reported since 1971 ... which assessed variables in association with responsible environmental behavior and which reported empirical data on this relationship. . . . An analysis of data [from these studies] resulted in the emergence of a number of major categories of variables which had been investigated in association with responsible environmental behavior. . . In the end, fifteen separate variables were meta-analyzed in an effort to determine the strength of their association with environmental behavior. (p.3)

From this scientific analysis, a model of responsible environmental behavior emerged. This model is displayed in Figure 2. In discussing this model, Hines et al. made the following inferences:

> An individual who expresses an intention to take action will be more likely to engage in the action than will an individual who expresses no such intention. . . . However, . . . it appears that intention to act is merely an artifact of a number of other variables acting in combination, e.g., cognitive knowledge, cognitive skills, and personality factors.
>
> Before an individual can intentionally act on a particular environmental problem, that individual must be cognizant of the existence of the [issue]. Thus, knowledge of the [issue] appears to be a prerequisite to action.

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[An] individual must also possess knowledge of those courses of action which are available and which will be most effective in a given situation.

Another critical component . . . is skill in appropriately applying this knowledge [i.e., knowledge of action strategies] to a given [issue].

In addition, an individual must possess a desire to act. One's desire to act appears to be affected by a host of personality factors. . . . locus of control, attitudes [toward the environment and toward taking action], and personal responsibility [toward the environment].

Situational factors, such as economic constraints, social pressures and opportunities to choose different actions may . . . serve to either counteract or to strengthen the variables in the model.

An Evolution of the Behavior Model

Concurrently with or subsequent to the Hines et al. research, a number of other researchers were making substantial contributions to the literature on behavior (Borden 1984-85; Borden and Powell 1983; Holt 1988; Koslowsky et al. 1988; Marcinkowski 1989; Ramsey 1989; Sia et al. 1985-86; Simpson 1989; Sivek 1989). Some of this research focused on the precursors (predictors) of behavior and some on the outcomes observed from instructional strategies which incorporated a number of the variables from the Hines et al. model.

These studies, coupled with the Hines et al. model, revealed that there are probably three categories of variables that contribute to behavior. The variable categories (entry-level variables, ownership variables, and empowerment variables) are hypothesized to act in more or less of a linear fashion, albeit a complex one. These variables are displayed in Figure 3, the behavior flow chart.

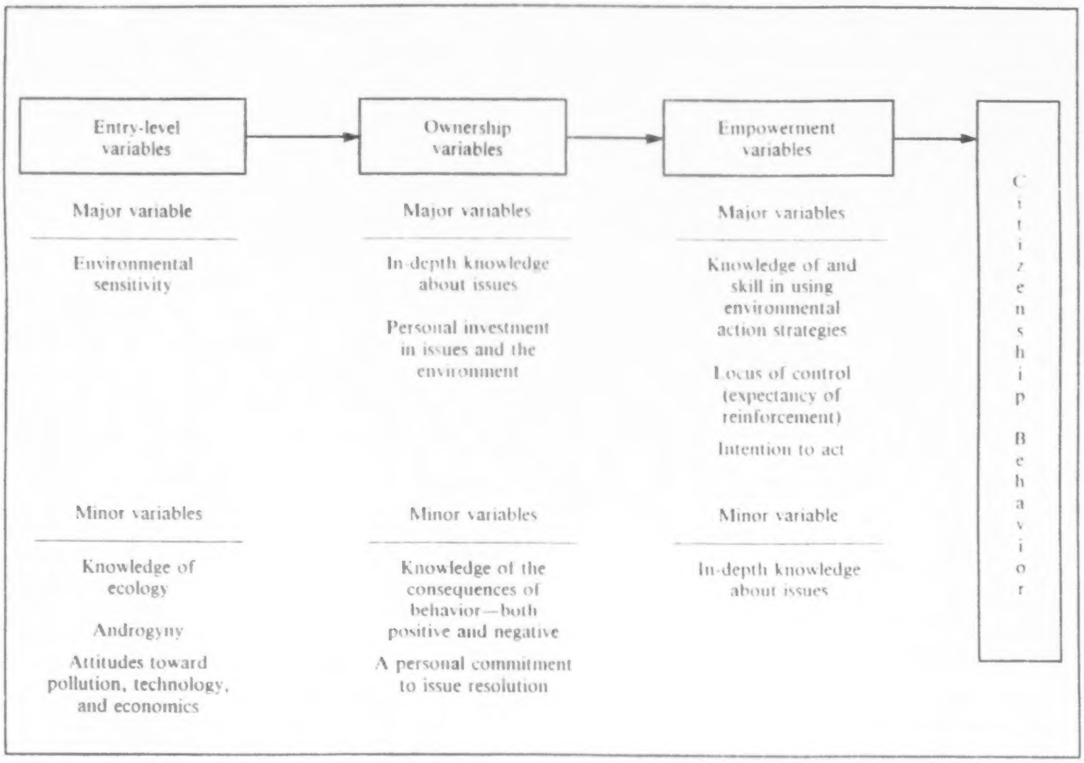
Entry-level variables
Ownership variables
Empowerment variables
Citizenship Behavior
Major variable
Environmental sensitivity
Major variables
In-depth knowledge about issues
Personal investment in issues and the environment
Major variables
Knowledge of and skill in using environmental action strategies
Locus of control (expectancy of reinforcement)
Intention to act
Minor variables
Knowledge of ecology
Androgyny
Attitudes toward pollution, technology, and economics
Minor variables
Knowledge of the consequences of behavior—both positive and negative
A personal commitment to issue resolution
Minor variable
In-depth knowledge about issues

Figure 3. Environmental Behavior Model: Major and Minor Variables Involved in Environmentally Responsible Behavior.

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Variables in the Behavior Flow Chart

In the discussion that follows, an attempt is made to describe the variables listed in the behavior flow chart. At certain points, comments are made about the synergistic relationship that appears to exist between certain closely related variables. The reader is cautioned to keep in mind that all of the variables discussed below probably operate in some sort of synergistic manner. While the categories of variables probably operate in a linear fashion, the variables within each category do not necessarily operate in a similar manner. It should also be noted that more research is needed to fully understand the relationships between these variables and behavior.[2]

Entry-Level Variables

Entry-level variables are good predictors of behavior or ones that appear to be related to responsible citizenship behavior. These appear to be prerequisite variables or, at the very least, variables that would enhance a person's decision making, once an action is undertaken. These variables will be briefly introduced here. Subsequently, several will be discussed in more detail.

Environmental sensitivity is defined as an empathetic perspective toward the environment. It is the one entry-level variable that has shown a dramatic relationship to behavior in the research.[3] Given these data, considerable attention must be given by environmental educators to this variable.

Androgyny [in a psychological sense] is a variable that is often associated with individuals who are active in helping resolve environmental issues. Androgyny refers to those human beings who tend to reflect nontraditional sex-role characteristics. For example, an androgynous male may be a very sympathetic individual and able to cry in a sad situation (a traditional female characteristic). An androgynous female, for example, may exhibit certain male characteristics such as assertive behavior. Androgyny is not as strong a predictor as environmental sensitivity.

Knowledge of ecology is listed here because it is almost always prerequisite to sound decisions regarding solutions to issues. "Knowledge of ecology" refers to an ecological conceptual basis for decision-making, e.g., concepts associated with population dynamics, nutrient cycling, succession, homeostasis, etc. The research would indicate that knowledge of ecology does not, in itself, produce environmental behavior. Still, it is an important variable when one considers the importance of ecological concepts in decision making.

Attitudes toward pollution/ technology/ economics are variables that have shown themselves to be significant in some of the research.[4] Although these attitudes appear to be involved with behavior, the extent of their involvement is still unknown and, thus, they are shown here as minor variables.

Ownership Variables

Ownership variables are those that make environmental issues very personal. The individual "owns" the issues, i.e., the issues are extremely important, at a personal level, to him/her. Much of what we know about "ownership" is inferred from a variety of studies. Ownership variables appear to be critical to responsible environmental behavior.

In-depth knowledge (understanding) *of issues* appears crucial to ownership. A number of important studies have addressed this variable.[5] It appears that, before individuals can engage in responsible citizenship behavior, they must understand the nature of the issue and its ecological and human implications. When individuals have an in-depth understanding of issues, they appear more inclined to take on citizenship responsibility toward those issues.

Personal investment in an issue or an action is another variable that we hypothesize to be a major factor in this category. Personal investment is much like "ownership" itself. Here the individual identifies strongly with the issue because he/she has what might be called a proprietary interest in it. For example, an individual who thoroughly understands the economics of recycling and who uses a substantial amount of recyclable material might feel a substantial personal economic investment in recycling. However, the motivation might not necessarily have to be economic. It could be environmental in nature if the person has good ecological concepts about waste disposal, biodegradability and nutrient cycles and understands the broad human involvement in these things. Recycling might, then, become a strong personal need which could be translated as "personal investment."

Empowerment Variables

Empowerment variables are crucial in the training of responsible citizens in the environmental dimension. These variables give human beings a sense that they can make changes and help resolve important environmental issues. "Empowerment" seems to be the cornerstone of training in environmental education. Unfortunately, it is a step that is often neglected in educational practice. A discussion of "empowerment variables" follows.

Perceived skill in using environmental action strategies is one of the very best predictors of behavior.[6] Simply put, perceived skill in using action strategies can be translated as human beings believing that they have the "power" to use citizenship strategies to help resolve issues. Further, these skills are fairly easy to teach to learners.

Teachers trained in this strategy report that students tend to develop a great deal of self-confidence as a result of this training. Training in action skills also results in improved students' self-concepts and a belief that they have been more fully incorporated into society. These are very powerful considerations when making students more responsible citizens in their own communities.

Knowledge of environmental action strategies is a variable that sometimes shows a relationship to behavior in the research (Holt 1988; Klingler 1980; Ramsey 1989; Ramsey et al. 1981; Simpson 1989). The extent to which this variable is separate and apart from "perceived skill in using action strategies" is unknown. It is probable that the skill component is dependent on the knowledge variable to a great extent. Knowledge about action strategies per se is not as powerful a predictor as the skill variable. This explains why these two variables are listed together in the behavior flow chart.

A word of caution may be necessary here. In the studies that examined behavior, learners gained an in-depth knowledge of issues as well as learning about action strategies. It is suspected that these two major variables operate synergistically, not separately. Thus, it would appear unlikely that citizenship action skills taught without issue-related knowledge would prompt responsible behavior in individuals.

Locus of control, although not as good a predictor as perceived skill in using action strategies, is important also, and, like many of the other variables discussed here, this one is probably interconnected with others.

Locus of control refers to an individual's belief in being reinforced for a certain behavior. A person with an "internal locus of control" expects that he/she will experience success or somehow be reinforced for doing something. Success, in turn, appears to strengthen his/her internal locus of control. On the other hand, a person with an "external locus of control" does not believe that he/she will be reinforced for doing something and, therefore, probably will not do it.

An individual who believes that he/she has good fishing skills is more likely to attempt fishing because there is an expectation of success or reinforcement for this behavior. This person has an internal locus of control for fishing. An individual who believes that he/she is powerless to make changes in society probably will not act in a citizenship dimension. There is no expectation of success or reinforcement for acting. This person would have an external locus of control for trying to help resolve environmental issues.

An internal locus of control probably cannot be developed *directly* in the classroom. However, there is research that indicates that locus of control can be improved as a consequence of teaching citizenship action skills. An improved locus of control may well result when students have had an opportunity to apply these skills successfully in the community.

Intention to act seems also related to the "empowerment" variable. If a person intends to take some sort of action, the chances of that action occurring are increased. It is likely that this variable is closely related to both perceived skill in taking action and locus of control. "Intention to act" may also share a synergistic relationship with "personal investment," which was discussed earlier under the "ownership" heading.[7]

Goals and Objectives for Instruction in Environmental Education

Behavior in the environmental dimension can be perceived as so very complicated as to make instructional planning difficult. This difficulty (as well as a lack of research into the precursors of behavior and instructional strategies designed to change behavior) probably resulted in the model that knowledge leads to awareness which leads to behavior.

There has been a great deal of criticism about the lack of direction in EE over the past 15 years.[8] The lack of emphasis upon objectives that focused on helping students actually solve environmental problems and develop problem-solving skills is contrary to the recommendations for environmental education objectives contained in both the 1977

Belgrade Charter and the 1977 Tbilisi Intergovernmental Conference Report.[9]

The answer to some of these concerns might be found in instructional goals for environmental education that incorporate the variables related to "ownership" and "empowerment."[10] Such a set of goals was developed in the early '80s and has subsequently been used throughout the world as a guide for curriculum development and research. This set of goals identifies a "superordinate goal" which follows:

> *The superordinate goal:* . . . to aid citizens in becoming environmentally knowledgeable and, above all, skilled and dedicated citizens who are willing to work, individually and collectively, toward achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment.

Four major goal levels as well as subgoals were developed to help accomplish the superordinate goal. The goal levels are presented below.

> *Goal Level I: The Ecological Foundations Level.* This level seeks to provide learners with sufficient ecological knowledge to permit him/her to eventually make ecologically sound decisions with respect to environmental issues.
>
> *Goal Level II: The Conceptual Awareness Level-Issues and Values.* This level seeks to guide the development of a conceptual awareness of how individual and collective actions may influence the relationship between quality of life and the quality of the environment and, also, how these actions result in environmental issues that must be resolved through investigation, evaluation, values clarification, decision making, and finally, citizenship action.
>
> *Goal Level III: The Investigation and Evaluation Level.* This level provides for the development of the knowledge and skills necessary to permit learners to investigate environmental issues and evaluate alternative solutions for solving these issues. Similarly, values are clarified with respect to these issues and alternative solutions.
>
> *Goal Level IV: Action Skills Level-Training and Application.* This level seeks to guide the development of those skills necessary for learners to take positive environmental action for the purpose of achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment.

Educating for a Change in Behavior

What Are the Critical Educational Components?

Given all that has preceded this section, one should be able to identify a number of critical components of a total educational program for environmental education if changes in learner behavior are desired. Among these critical components are ones which can be facilitated by formal and nonformal educational agencies (see Table 1).

Comments on Implementing the Critical Components

Certainly, there is no one best way to implement these components in an instructional setting even though the research provides the reader with some meaningful clues concerning important and successful strategies. And it may be that it will take a concerted, cooperative effort among educational institutions to meet the challenge of changing learner behavior. Certainly, an articulated implementation across grade levels and the cooperation of nonformal educational agencies as well as local and regional educational resources would maximize the opportunity for success.

What are some successful strategies for meeting the implementation challenge? What are some cautions that should be kept in mind while implementing the important components? Most of the components listed in Table 1 will be discussed here in some detail. However, first let us focus on at least one overall strategy that seems to be especially critical.

The Need for a Reinforcement Strategy

Educators must not assume that one course or one unit or one year of training will accomplish the task needed even though a number of studies have shown that certain strategies for changing behavior are successful (Holt 1988; Klingler 1980; Ramsey 1989; Ramsey et al. 1981; Simpson 1989).[11] Associated with one of these studies (Ramsey et al.

TABLE 1. Critical Education Components

It appears that we can maximize opportunities to *change learner behavior* in the environmental dimension if educational agencies will:

1. teach environmentally significant ecological concepts and the environmental interrelationships that exist within and between these concepts;
2. provide carefully designed and in-depth opportunities for learners to achieve some level of environmental sensitivity that will promote a desire to behave in appropriate ways;
3. provide a curriculum that will result in an in-depth knowledge of issues;
4. provide a curriculum that will teach learners the skills of issue analysis and investigation as well as provide the time needed for the application of these skills;
5. provide a curriculum that will teach learners the citizenship skills needed for issue remediation as well as the time needed for the application of these skills; and
6. provide an instructional setting that increases learners' expectancy of reinforcement for acting in responsible ways, i.e., attempt to develop an internal locus of control in learners.

1981) was an important but unpublished follow-up investigation conducted three years after Ramsey measured the effects of three different treatments on the environmental behavior of eighth-grade students.

Three years after Ramsey completed his initial investigation, he trained several graduate students to act as interviewers and took them to the secondary school where the original subjects were students. The interviewers were trained to assess the extent of student involvement in environmental issues and environmentally appropriate behavior. The interviewers were not told which students had been in the experimental group and which had been in either of the control groups. Interestingly, the interviewers could identify each of the students who had been in the experimental group. The subjects *were involved in more environmentally appropriate behaviors* than their counterparts. However, it was clear that the original behavior observed in the eighth grade had eroded over time. There had been no intervening educational reinforcement for the students over a three-year period. Thus, it seemed obvious that, even though the experimental subjects were more environmentally involved, some sort of intervening treatment would have been needed to maintain the original level of involvement.

In light of Ramsey's follow-up study, it seems obvious that learners need to be reinforced for positive environmental behavior over time. No definitive recommendations about the extent of instructional reinforcement will be made here. There is simply no research to validate how much is needed. However, it is evidently imperative that learners get in-depth educational experiences over a substantial amount of time.

Thoughts on the Sensitivity Component.

Environmental sensitivity is a particularly troublesome variable for many educators who understand its importance. The variables associated with sensitivity are often not associated with formal education.

Several research studies have focused on "sensitivity" (Peters-Grant 1986; Peterson 1982; Scholl 1983; Tanner 1980). These studies yielded similar results concerning the precursors to environmental sensitivity. It appears that "environmental sensitivity" is a function of an individual's contact with the outdoors in relatively pristine environments either alone or with close personal friends or relatives. The environmentally sensitive individuals reported hunting, fishing, and other outdoor activities as important variables. Of great importance is the fact that they reported that these activities took place over long periods of time.

Numerous sensitive individuals reported that some experience with severe environmental degradation substantially increased their environmental sensitivity. Some sensitive individuals reported the importance of teachers who acted as sensitive role models for them. Others reported being raised in an environmentally sensitive social environment. Only a few reported the importance of educational courses or books.

If these research studies are to help us make educational decisions about developing environmental sensitivity, it seems important that learners have environmentally positive experiences in nonformal outdoor settings over long periods of time. And, in the formal classroom, we must look to teachers who are, themselves, sensitive and willing to act as positive role models for learners. Both of these conditions, for millions of learners, are hard to meet.

Accomplishing the Issue Investigation, Action, and Knowledge Components: Two Recommended Approaches.

These variables are collapsed together in this heading because there is research evidence that these can be met simultaneously in a formal instructional setting. (Holt 1988; Klingler 1980; Ramsey 1989; Ramsey et al. 1981; Simpson 1989). In each of these studies, behavior changed positively as a consequence of instruction that focused on ownership and empowerment. Of great importance is the fact that, in all cases, students were shown to participate in more environmentally appropriate behaviors out of school after instruction.

The instruction used in each of these studies focused on the goal levels cited earlier with the exception of the ecological foundations goal. That particular goal (ecological foundations) was met earlier in the learner's schooling. Thus, Goals II, III, and IV were part of the instructional design. In all cases, the instruction involved the use of one of two curricular strategies (Hungerford et al., 1988; Marcinkowski, et al. 1990; Hungerford, et al. 1990).

Two Curricular Strategies: the Issue Investigation and Action Model and the Extended Case Study Model

In the issue investigation and action model, the student learns to discriminate between environmental events, problems, and issues. The impact of beliefs and values on issues is emphasized, and an issue analysis strategy is introduced and practiced. Students then learn how to identify environmental issues, write research questions focused on these issues, and learn how to obtain information about issues using secondary sources. They also learn how to compare and evaluate secondary information sources. They then learn how to develop surveys, opinionnaires, and questionnaires and how to sample populations in order to obtain scientifically valid information. In addition, they are taught how to record data, interpret the data, make inferences about the data and draw recommendations from these inferences. At this time, each student chooses an issue of particular interest to him/her and investigates that issue in depth. Subsequently, the student prepares a report on that investigation and tenders a written report to the instructor and an oral one to his/her peers.

After the students have completed their issue investigations, they learn the major methods of citizenship action, analyze the effectiveness of individual action versus group action, and develop issue-resolution action plans. This action plan is evaluated against a set of criteria designed to assess the social, cultural, and ecological implications of the action. Finally, the students decide whether they want to actually implement the plan of action. If they choose to implement their action, the instructor helps to facilitate this citizenship behavior.

In the extended case study model, the students learn some of the same skills that were learned in the other model except that they do so focused on a predetermined issue, sometimes chosen by the class but most often chosen by the instructor. The research indicates that the extended case study model, although successful, is not as powerful an instructional model as the issue investigation and action model.

Selected educational characteristics of both models are illustrated in Table 2. The characteristics displayed are for ages 6 to 17 (Grades 1 to 12) only. It is important to note, however, that the issue investigation and action model has been used very successfully with both undergraduates and graduate students in university teacher education programs in the U.S.[12]

Effectiveness of Environmental Education Around the World

Has environmental education been effective on a global basis? In citing evidence of success, we might point to nations that have made a concerted effort to mount environmental education programs. We might also note the many national and international leaders who are hard at work trying to implement EE. Numerous organizations also advocate and/or deliver environmental education programs. In addition, there are curricular materials from formal and nonformal educational agencies, media campaigns, adult education programs, outdoor education programs, conservation education programs, and other vehicles that attempt, in one way or another, to change human behavior in an environmental dimension.

Evidence of success might also be seen in the numerous stories telling what young students and adult activists have done regarding issues (see Appendix B for examples). Some of these anecdotes have originated from students who have learned issue investigation and citizenship action skills in school. Some of these anecdotes have originated from excellent conservation education programs designed to teach adolescents and preadolescents sound conservation practices. Some have originated from governmental agencies, which are funded to help humans learn how to conserve natural resources. Others come from private agencies that strive to help human beings confront issues and deal responsibly with the environment. Still others originate in agencies that have a major responsibility for environmentally related law enforcement.

Does this wealth of evidence speak to the effectiveness of environmental education? Before reaching that decision, it may be wise to consider additional evidence. We urge responsible citizens and educators to consider three main concerns.

Concern No. 1: We Seem to Be Losing the Battle for the Environment

Regardless of what we as educators would like to think, we can point to relatively few successes that offset the severity of environmental degradation and the serious problems associated with human reproductivity. This is a bitter concept for educators to accept. Although we are prone to defend our practices in EE, we must stop and evaluate how successful we are in the overall battle to resolve urgently important environmental issues. It is not our purpose here to put forward a litany of truly critical environmental issues facing human beings today. But, if we did, this listing would enormously outweigh the successes in changing environmentally related behavior around the world. *Thus, when current reports on environmental quality are considered, we must admit that we have not been successful, on a widespread basis, in convincing world citizens to act in environmentally responsible* ways.

Concern No. 2: There Are Too Few Sound National Strategies for EE

In numerous countries (including the authors' own), EE is a step-child of education, or it receives only sporadic attention. Relatively few nations have made a commitment to EE programs that involve students throughout their schooling and that utilize a carefully constructed, research-based scope and sequence. Where EE exists, students typically receive incidental exposure to environmental issues, with the emphasis on the ecological foundations and/or awareness levels. *Thus, there appear to be few concerned nationally focused efforts that prepare future citizens to make environmentally sound decisions or to participate responsibly in environmental maintenance and remediation. As a result, only a fraction of our young learners are being exposed to logically developed, well-articulated EE programs.*

Further, there are relatively few efforts to try to change environmental behavior through the media. Certainly, there are nations that can point to television programming that focuses attention on environmental issues, wildlife, or natural ecological systems. In almost all instances, however, these media presentations deliver information about the environment and about environmental issues. Few media events focus on skills associated with individual citizen's ownership and empowerment. Similarly, with few exceptions, the number of people watching these programs is relatively small compared with the population as a whole. Further, when print sources are focused on environmental issues, those issues are frequently ones that appear newsworthy to editors, and coverage is almost totally at an issue awareness level. Without opportunities for ownership or empowerment, it appears unlikely that these efforts will move the public to widespread participation in environmental responsibility. *Thus EE media efforts tend to focus on the awareness level (which tends to be ineffective in changing behavior) and often fail to reach a large audience of learners.*

Concern No. 3: Educators Are Focused on the Wrong Strategies

A similar situation exists in the instructional materials used in formal educational settings. By and large, these materials are designed to provide information: information about ecology ... information about the environment ... information about environmental issues. Too few EE programs incorporate serious attempts to develop ownership and empowerment in learners. Again, these educational efforts typically focus only on the awareness level. Environmental educators overwhelmingly agree that the major aim of EE is to produce individuals who will willingly and responsibly participate in environmental maintenance and remediation. *Unfortunately, the majority of instructional materi-*

als in EE fail to develop skills associated with investigating and evaluating issues or with responsible citizen participation.

In addition, most success stories are issue-specific in nature. In other words, most successes revolve around educational efforts designed to help resolve specific issues. The knowledge and skills learned are focused on a particular issue, e.g., endangered species, solid waste management, safe water supplies, forest conservation, etc. We cannot argue the importance of attending to these issues where they are locally important. However, in many instances, this strategy is seriously flawed. The flaw in this one-issue strategy centers on "generalizability." It is relatively easy to get learners focused on an issue, particularly if it is one of interest or importance to them. In many instances, educators can also engage learners in citizenship action strategies related to that issue. Unfortunately, with a single-issue focus, there exists very little opportunity to generalize the knowledge and skills to other issues (unless they are closely related to the first one). *Thus the results of our efforts are learners who may act in an environmentally positive manner with relation to one issue (or set of issues), but who do not have the knowledge, skills, and willingness to assume environmental responsibility in their day-today lives.*

In Closing

One of the serious impediments to the kind of instruction recommended in this document is the fact that it differs substantially from typical educational practice. As stated before, most educators firmly believe that, if we teach learners about something, behavior can be modified. In some cases, perhaps, this is true. However, in educating for generalizeable responsible environmental behavior, the evidence is to the contrary. Typically, *issue awareness does not lead to behavior in the environmental dimension*. This means that we must look to a new model of instruction if behavior is important. And, because all environmental behavior is somehow issue related, it appears as though *issues must be the focus of instruction* beyond environmental sensitivity, ecological foundations, and issue awareness.

If environmental issues are to become an integral part of instruction designed to change behavior, instruction must go beyond an "awareness" or "knowledge" of issues. Students must be given the opportunity to develop the sense of "ownership" and "empowerment" so that they are fully invested in an environmental sense and prompted to become responsible, active citizens.

The research is very clear on the matter. Citizenship behavior can be developed through environmental education. The strategies are known. The tools are available. The challenge lies in a willingness to do things differently than we have in the past.

Acknowledgments

The writers are indebted to many human beings around the world who have worked diligently to make environmental education a meaningful experience for learners. We most certainly stand on the shoulders of giants and acknowledge their contributions to this paper (both instructionally and in a research context) . Only a few of these have been cited in order to make this document as readable as possible.

In the development of this paper, one person stands out above all others. Dr. Thomas Marcinkowski of [The Florida Institute of Technology] has been an enormous help to the writers and has assisted with the formulation of ideas and with the behavior model seen earlier. He should also be given credit for [furnishing] the bulk of the citations that appear in Appendix C of this paper.

Notes

1. The writers believe that the terms "problems" and "issues" should be used differently. Although some writers use these terms synonymously, distinguishing between them helps learners to conceptualize them differently. An environmental "problem" exists when something is at risk, for example, an animal becomes endangered. An environmental "issue" exists when human beings have differing beliefs and values concerning what should be done about the problem. For example, people may differ in their beliefs about what should be done to manage the endangered animal. This situation exists in very real dimensions throughout the world. A specific example would lie with the African elephant. Its endangerment is an environmental "problem." How to manage the elephant has become an "issue."

2. The model presented in this paper "reflects variables associated with the prediction of, modification of, and explanation for the relative frequency with which citizens engage in this broad [range] of behaviors. ... an emphasis has been placed on variables which may be attended to in educational pro-

grams, i.e., programs designed to modify the frequency of such behavior," (Marcinkowski 1990).

3. In the research conducted by Sia et al. (1985/86) sensitivity predicted nearly 13% of the variance in his overall sample. It predicted over 45% of the variance in his non-environmental group, a sample of 66 elders in an Elderhostel Program in southern Illinois. And, it predicted nearly 10% of the variance in his sample of environmental organization members. It was also a major predictor variable in the research conducted by Sivek (1989) for at least one of his environmentally allied groups in Wisconsin.

4. Marcinkowski (1989) found that these variables were significant predictors of behavior. Sia (1985/86) measured only pollution and technology and did not find them as salient as did Marcinkowski.

5. Using curricula that involve students in investigating and evaluating issues, Holt (1988), Klingler (1980), Ramsey (1989), Ramsey et al. (1981), Simpson (1989) and others have demonstrated that middle school students definitely participated in more positive environmental behaviors subsequent to that instruction. Ramsey et al. (1981) also confirmed this observation by surveying the parents of the students.

6. In Sia's research (Sia et al. 1985), perceived skill in using environmental action strategies accounted for nearly 35% of the variance for predicting environmental behavior when all of the samples were considered together.

7. Koslowsky et al. (1988) studied the impact of intention and investment on behavior (although their research was not conducted with respect to environmental issues). They found that "maximum prediction is attained by using only two variables, intention and investment, and their interaction." The research conducted by Hines et al. (1986/87) looked at "intention to act" as a contributing variable to environmental behavior. They suggested that "intention to act" appears to be "an artifact of a number of other variables acting in combination, e.g., cognitive knowledge, cognitive skills, and personality factors."

8. There is no lack of criticism and comment in the literature about the lack of direction in environmental education. In 1975, Vande Visse and Stapp warned that " ... without a clear statement of goals, an environmental education program would become a series of unrelated experiences, focusing on limited program objectives." Roth, in 1976, confirmed this prediction by stating that "the presence of environmental education in public school curricula [U.S.A.] can often be characterized by loose organization and little sense of direction." In 1977, Harvey set about to analyze instructional models in the field and found that there was little agreement about what constituted a model for environmental education.

In 1978, Childress reported on a major research study into environmental education programs in the U.S. (surveying 301 EE programs and projects) and found that less than 40% of those surveyed considered the following objectives to be primary objectives: synthesizing various alternative solutions to environmental problems into a comprehensive plan; analyzing the role of contributing factors (technology, legislation, etc.) to the causes of environmental problems; evaluating how varying value systems modify and shape the environment; and developing proficiency in environmental data collecting techniques.

Childress concluded from his study that objectives focused on helping students become knowledgeable about their environment and its associated problems, and developing an appreciation of environmental resources, were considered of more importance in a majority of programs than objectives focused on helping students actually solve environmental problems and develop problem-solving skills.

9. Several important research studies, not discussed here, have dealt with needs in environmental education relative to goals for EE. These provide substantial insight into the perspectives of teachers and EE professionals regarding the status of EE, both nationally and internationally, and specific needs for changes in curriculum, instruction, and teacher education. These would include Champeau et al. (1980); Peyton (1977); Stevenson (1986); UNESCO (1978); Volk et al. (1984) and Wilson (1988).

10. Using the Tbilisi objectives as a framework and Harvey's (1977) "Superordinate Goal for Environmental Education," Hungerford et al. (1978/1980) developed a set of goals and subgoals that appeared to be philosophically and hierarchically valid. An original set of goals was presented to a working group of the 1978 National Conference on Environmental Education [U.S.A.]. A revised set of validated goals was then published in 1980.

11. Among these studies are the Asche and Shore (1975) research on conservation behavior conducted in Canada and the Ramsey studies with seventh and eighth-grade students (Ramsey et al., 1981; Ramsey 1989) conducted in the U.S.

12. With respect to the two instructional models recommended here, the issue investigation and action model and the extended case study model, examples of these are commercially available and can be obtained from Stipes Publishing Company, 10 Chester Street, Champaign, Illinois (USA) 61820. The Issue Investigation and Action Model is entitled *Investigating and Evaluating Environmental Issues and Actions* (Hungerford et al. [1996]). The Extended Case Study Model is entitled *A Science-Technology-Society Case Study: Municipal Solid Waste* (Ramsey et al. [1996]).

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Appendix A: Goals For Environmental Education

[Note: Appendix A has been deleted from this reading since the original document can be found in its entirety elsewhere in this book. That article was originally published in the Journal of Environmental Education in 1980 and was entitled, "Goals for Curriculum Development in Environmental Education."]

Appendix B:
Citizenship (Action) Vignettes

Central Illinois, United States

After surveying local residents regarding their attitudes toward the recycling of aluminum beverage containers, an eighth-grade student in a medium-sized town in central Illinois visited the mayor and shared the results of her issue investigation and survey. The mayor was so impressed with her findings that he invited her to address the city council. As a result of her survey and work with the city council, the town now has two recycling centers.

Cameroon

In Cameroon, an agricultural extension officer visits a village and teaches the farmers how to cultivate their land on the contour in order to keep soil from washing away. Instead of cultivating crops uphill and downhill as they had done before, they now work the land so as to save valuable top soil.

Midwestern United States

In a rural Midwestern community in the U.S., several junior high students became interested in a local land-use issue. The debate centered on the use of a section of state-owned land adjacent to a local river. After conducting a county-wide survey, these students used their findings to develop a master plan for the use and development of that public land, and submitted and defended the plan at a public hearing sponsored by the state Department of Conservation.

Among the farmers, businessmen, bird watchers, recreationists, and others who spoke at the public hearing, these students were the only participants who presented a proposal founded on data-based decision making. The master plan, which was ultimately adopted, was very similar to their proposal.

Canada

In an activity-centered program, a Canadian conservation camp director teaches middle school students appropriate conservation behaviors relating to soil, water, forests, and wildlife. Subsequent observations of this group in the out-of-doors indicates that they now practice those behaviors when not under adult supervision. Observations made of a control group indicate dramatic differences between the two groups.

Kentucky, United States

A middle school student in rural western Kentucky became interested in water treatment in her community. After obtaining a water testing-kit from her local water utility, she tested her household water supply as well as the supply at the local school. Alarmed at the abnormally high chlorine content, she contacted community officials, who retested the water and confirmed her findings.

This young lady was commended by community officials for her discovery and assured that prolonged exposure to those high rates might have indeed had negative effects on the health of the students.

Australia

In Australia, students became concerned over the possible loss of a stream and floodplain near Melbourne. They decided, with the help of their teacher, to thoroughly investigate this issue. They studied the area's biology, hydrology, and geology. They investigated the development plans and the attitudes of local residents and authorities toward preservation and development. Using this information, they then worked out an action plan that focused on the area's biological and educational values. They then advocated this plan in numerous ways throughout the community. The local council accepted this plan and the area was saved from development.

United States

Two eighth-grade students in the U.S. decided to see if bottle bills (legislation supporting a deposit on beverage containers) really are workable solutions to roadside littering and to the use of a limited resource. They wrote to officials in each of the states that have such legislation and collected information on effectiveness, administrative costs, and on the perceived positive and negative effects of the legislation.

Garnering the support of their colleagues and then of citizens in three other area communities, these two students developed a "Bottle Bill Coalition" to lobby lawmakers. The two students, who had spearheaded the coalition, convinced their friends to collect aluminum cans, clean them, crush them, and package them in one-pound bundles to mail to all the committee members. Each aluminum bundle was accompanied by a petition supporting the proposed legislation. Although their state still does not have a bottle bill, that legislative session witnessed the passage of a bill which banned the removable tab considered harmful to humans and other animals.

Missouri, United States

Two secondary students in a large urban area in Missouri noticed the increasing deterioration of their neighborhood. Upon investigating, these students discovered that a large corporation, after failing at an earlier attempt to re-zone the neighborhood for business development, had been quietly buying up residences and allowing them to deteriorate. The students interviewed neighborhood residents, documented the actions of the corporation, and presented their findings to the city council.

New England, United States

A 12-year-old student in New England discovered that a much-loved, 17-acre, bog-like forest was being considered as a site for a multi-million-dollar condominium development. He decided that this development simply couldn't take place. Not only did he really care for this land and for the many living things there, he felt that the area was too wet for development.

This student investigated the status of that acreage and, when he had hit facts straight, he began a letter campaign to his legislators and the local TV station. He also circulated a petition against the development, which was well received in the community. Hesitantly but resolutely, he gathered support and began attending town meetings with his supporters. He successfully challenged the development. Interestingly, he received an award from his school for community service and another from the U.S. Environmental Protection Agency. Even the United Nations Environmental Programme selected him for an award.

East Coast, United States

A 15-year-old student on the east coast of the United States became concerned about the use of polystyrene trays in the school's cafeteria. Polystyrene is a plastic foam, often used for food containers, which does not decompose. Along with other plastic, it takes up space in landfills, which is always limited. Each foam tray, however, costs a nickel less than a similar pressed paper tray.

This student thought that her schoolmates would be willing to pay the extra nickel in order to help the environment. Her classmates agreed. They conducted a survey of all students in the middle school and the high school and found them willing to pay the extra nickel. Then, they set about to persuade the school board. The school board asked the students to demonstrate that willingness. The students would have a week in which they could purchase their lunches on either paper or plastic trays. During that week, nearly three-fourths of the high school students and an even greater fraction of the middle school students paid the extra money. As a result, an all-paper tray policy was put into effect in all of the district's schools. Following the students' lead, the township council also suggested substituting paper for polystyrene in municipal buildings.

Appendix C: Additional Literature Of Relevance

Theoretical Works and Reviews of Research

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The Pros and Cons of Research in Environmental Education

Nicholas J. Smith-Sebasto

In this paper Dr. Smith-Sebasto provides his assessment of the state of environmental education research. He considers areas that expose the field to criticism as well as those areas that strengthen the mission and provides recommendations about research needs that should move the field forward.

The Need for Research in Environmental Education

Education is a research-based discipline (Crowl, 1996, p. 3). Presumably, this contention includes environmental education. Unfortunately, many perceive EE as either not being research based - neither in subject matter nor theory and practice - or as being based on inadequate research. Perhaps, this is because as O'Hearn (1982) once suggested, EE is notoriously difficult to evaluate because humans – the ultimate focus of EE research – do not often, if ever, lend themselves to rigid experimental control. Perhaps it is because of far more serious reasons, including the lack of a defensible research base.

Since so many have been so vocal lately about the shortcomings of EE, I will begin my assessment with what I think is bad, the cons, with EE research. Criticisms of EE research have been expressed for nearly as long as the field has been recognized as having a distinct scholarly focus. These criticisms have often been scathing. For example, Lewis (1981-82) opined that there

> is a distinct shortage of well controlled studies reporting classroom methodologies for environmental education [and] studies which are reported are lacking in methodological rigor and their validity is questionable (p. 15).

He recommended that reports of the efficiency of classroom EE methodologies should include at a minimum:

- the age of the subjects;
- the number of subjects;
- a detailed description of the research methods sufficient to permit replication;
- a control group;
- a detailed description of the nature of the evaluation including, if applicable, the name of the instrument used, sample items if a researcher developed instrument is used, and evidence of reliability and validity of the data;
- a disclosure of the exact length of the treatment; and
- a detailed discussion of the criteria for accepting or rejecting the findings of the study (p. 14).

Stewart (1982) observed that "the empirical research reported in [*JEE*] often exhibits a lack of thoroughness and rigor" (p. 42). He cautioned that if

> empirical research in [EE] is to be taken seriously, increased attention must be given to developing consistent and logical reports of research findings. If researchers do not take their work seriously, then it is unlikely that [EE] practitioners will. Or, worse, practitioners may take the work seriously when it should be discounted (p. 42).

His specific criticisms were that articles published in *JEE* did not:

- define key concepts related to the research,

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- contain explicit statements of the research questions,
- indicate how the claims put forth were related to the questions, and
- adequately describe treatments.

Regarding research involving the affective domain, Iozzi (1989) suggested that a

> problem that one finds in examining the volume of research in [EE]...is that many of the studies lacked the necessary rigor that one would expect in scholarly research pursuits. For example, many of the studies were poorly designed, lacked appropriate controls, utilized faulty or inadequate instruments (e.g., instruments frequently lacked validity and/or reliability, or employed inappropriate and less than rigorous statistical procedures (p. 4).

Open, two-way dialogue about the merits and demerits of published reports are fairly uncommon in EE journals. However, in one such dialogue Marcinkowski (1988/89) criticized a study by Monroe and Kaplan (1988). He argued that they had not satisfactorily addressed the limitations of their study, improperly compared the findings of their study to another, "failed to control for several variables critical to such a comparison" (p. 3) and offered conclusions that "seem to emerge more as suggestions from the researchers than as conclusions from the data" (p. 4).

Gigliotti (1990) suggested that EE researchers "need to spend more time and research on problem definition," arguing that by not doing so

> we waste effort researching misdiagnosed problems. We rush in and look for solutions before we fully understand the problems.... (p. 11).

In their study of 34 published manuscripts, Leeming, Dwyer, Porter, and Cobern (1993) concluded that although

> several of the studies...appeared to have found positive effects on environmental attitudes, knowledge, and behavior, much of the utility of these findings was mitigated by problems of experimental design and data analysis (p. 20).

They offered the recommendation that investigators

> must become more sensitive to the importance of rigorous designs that include meaningful control groups, controls for expectancy effects, use of reliable and valid dependent measures, follow-up data, and appropriate unit analyses (p. 20).

Naish (1993) suggested that EE research

> is often small scale and underfunded. It is, therefore, frequently found to be based on unsatisfactory samples, idiosyncratic in character and lacking in reliability and validity. It is seldom possible to generalise from such research findings (p. 64).

He further suggested that the field of EE should have "a clear set of criteria by which to judge" research in the field (p. 64). McElroy (1993) echoed this notion suggesting that criteria "will vary according to the nature of the research problem and procedures, but certain principles should always be evident" (p. 66). Nevertheless, as Purnell (1993) suggested, the

> formulation of specific criteria by which one may categorise...[EE] research into that which is quality and that which is not, [is] a rather daunting task. It may indeed prove easier to identify those sorts of things that make research fit into the category of 'what's not quality'! (p. 70).

I find each of the preceding assessments defensible. In fairness to the EE field, however, such criticisms of research do not reflect a condition unique to EE. For example, a faculty member on my campus who is an Associate Editor for the *Journal of Environmental Quality* (*JEQ*), reported during a recent seminar that 39 percent of all manuscripts submitted to *JEQ* are rejected on the basis of scientific inadequacy, 33 percent are rejected because they were poorly written, 13 percent are rejected because the subject matter is inappropriate for the journal, and 11 percent are rejected because they ignored *JEQ* format and style. Considerations leading to a rejection based on scientific inadequacy included:

- the manuscript offered "no new insights on the topic,
- the manuscript lacked depth and rigor to be a journal article,
- the goal(s) and scope of the study were not given,
- there were too few samples to be representative of a population,
- the sample(s) was poorly described,
- there were too few (if any) replications of measurements,

- the experiment design was flawed,
- the procedures were flawed or poorly designed, and
- there were insufficient data to support conclusions.

Still, pointing to the fact that other fields and journals publishing research reports in these fields are encumbered by the same limitations as EE is not a remedy for the problem. Perhaps the only real remedy is to respond to Volk's (1990) question, "Why aren't we teaching...the basics of research?" by including research considerations in the development of students pursuing careers in EE. Additionally, EE researchers and journal editors need to invest more effort into the publication of manuscripts that may serve as references for students and scholars conducting EE research. Additionally, Mrazek's (1993) question: How do researchers address the many demands suggested by the various definitions of [EE]? (p. 16) must be carefully investigated if the goals of EE and the quest for ecological sustainability are to be realized.

So as not to seem overly negative, let me state that I recognize that there are some excellent reports of EE research findings/results. For example, Leeming et al., in reporting 34 studies they reviewed, noted that thirty-one of these would have to be viewed with skepticism due to the probability of Type I error. However, with regard to the remaining three, they stated that the

> . . . 3 with children as subjects that used an appropriate unit of analysis were conducted by Armstrong and Impara (1991), Fennessey et al. (1974), and Ramsey and Hungerford (1989), and only Ramsey and Hungerford found significant effects.

Leeming et al., in a congratulatory mode, also went on to specifically cite Armstrong and Impara (1991) as well as Horsley (1977) as "models for future" EE research. But, much as the proverbial squeaky wheel, the bad not the good frequently gets the most attention.

To reflect on the state EE research without considering EE practice would represent only a partial analysis. I am, therefore, providing this background on what has and is being expressed regarding EE practice. EE practice has been severely criticized, which, if Crowl is correct about education's research foundation, is not surprising given the criticisms of EE research. In accusations often without foundation or merit and from individuals funded by and/or representing extremely right-wing institutions with an obvious political agenda, EE practice has been accused of being "more focused on advancing particular political agendas than...on educating our children about the natural world" (Adler, 1993a, p. 11) and of "merely proselytizing and promoting pet causes" (Adler, 1993b, p. A14). Kwong proposed that "To some, environmental education poses one of the greatest threats to the moral education of our kids" (1995, p. 7). I have not heard many of these types of accusation from individuals trained in EE or recognized as bona fide members of the EE practice or research community. I am not suggesting that these accusations are completely without merit; some of them are valid and expose the field to significant criticism. I am suggesting that the type of EE such critics point to when making their assessments does not represent the majority of EE. These types of accusations, nevertheless, make the pages of the New York Times as well as other media sources that unquestionably have an effect on the public's agenda. For example, as a result of such concerns publicized by the mass media, Arizona overturned a 1990 law mandating EE in its public schools, and similar efforts are being considered in Texas, Florida, Wisconsin, and North Carolina (Satchell, 1996, p. 63).

Given the findings of several survey research efforts, including those by polling organizations such as Roper Starch and Gallup, which imply that the ecological literacy of the general public is unsatisfactory and that performance of environmentally responsible behaviors is quite low, assessment of both EE research and practice is vital.

The current data support Gigliotti's (1990) contention that despite over two decades of concerted effort, the field of EE has in large measure, but not universally

> produced ecologically concerned citizens who, armed with ecological myths, are willing to fight against environmental misdeeds of others but lack the knowledge and conviction of their own role in the environmental problems....[T]he necessary changes in values have not really occurred. Instead, people have selectively screened the [EE] messages and constructed belief structures to support their own value systems rather than alter their lifestyles to any great degree (p. 9).

Perhaps, no more painful example of Gigliotti's contention exists than the now famous Meryl Streep - Natural Resources Defense Council - 60 Minutes alar issue debacle, in which the movement to advocate environmental protection suffered not only embarrassment, but also a loss of credibility.

Additionally, the data support Van Matre's (1993) concern that

> you wouldn't claim you had a satisfactory reading program if most of your learners couldn't read at the end, or an adequate drivers training program if they ended up unable to drive, but many leaders will say they have a complete [EE] program even though most of their learners don't end up doing anything specifically to live more lightly on the [E]arth (p. 16).

As with Gigliotti's suggestion, Van Matre's perception certainly is not universally true, but given the persistence of environmental problems, it is clear that the sustained performance of behaviors conducive to ecologically sustainable development have yet to be adopted en masse. In fact, many indicators, examples including the return of large, gas-guzzling autos and the decline of recycling opportunities in many areas, actually suggest just the opposite.

A concern that "teachers and the designers of [EE] materials are rarely well-versed in environmental issues" (Adler, 1993b, p. 12) is at least in part supported by reports of the responses of inservice teachers to assessments of the status of EE in public schools (see, for example, Lane, Wilke, Champeau, & Sivek, 1994 and Smith-Sebasto & Smith, 1997).

The Independent Commission on Environmental Education (ICEE) recently concluded that . . . children still do not know much about the environment. It can be argued, and supported with some data, that some adults are equally ignorant about the environment, and that both some children and some adults are also ignorant about both . . . issues and the actions they may take to contribute to the resolution of environmental problems. . . . there is also some evidence that some current learners know more about the environment and/or environmental issues than did their predecessors.

The Independent Commission on Environmental Education (ICEE) recently concluded that after "twenty-five years of experience in [EE], children still do not know much about the environment" (1997, p. 7). It can be argued, and supported with some data, that some adults are equally ignorant about the environment, and that both some children and some adults are also ignorant about both many environmental issues and the actions they may take to contribute to the resolution of environmental problems. My experience teaching environmental science to both post-secondary students as well as inservice teachers sadly supports the ICEE's opinion. This point is, however, paradoxical, since there is also some evidence that some current learners know more about the environment and/or environmental issues than did their predecessors.

Perhaps the most curious perception of EE practice I have read in recent years appeared in the Proceedings of the National Academy of Science, in which Lynch and Hutchinson, both from Dartmouth College, suggested the need for a "new profession devoted to environmental matters" (1992, p. 864). They titled their paper "Environmental Education"! This new profession, they suggested, should be "focused fundamentally on the environment and standing alongside the established professions" (p. 864). Isn't that what most of the EE community would argue already exists? It is vital to note that what Lynch and Hutchinson propose under the title of environmental education is what many in the EE field wish existed - a comprehensive academic preparation including foundational studies in biology, chemistry, Earth sciences, engineering sciences, and physics, coupled with preparation in business and management, and public policy - but does not. In short they propose a comprehensive program that combines preparation in the applied and social sciences. That such comments should appear in the proceedings of such a prestigious academy should have raised concern by many in the EE field. After all, the name of the field had been usurped in a way analogous to someone publishing an article in *Science* suggesting the need for a new form of transportation designed with an internal combustion engine and called an automobile. Such a device already exists. EE also already exists; it just is not recognized by many, which may be due, at least in part, to the perception that the research base for the field - its foundation - is weak.

On the positive side regarding EE practice, the position of the World Commission on Environment and Development (1987) was that

> [EE] should be included in and should run throughout the other disciplines of the

> formal education curriculum at all levels - to foster a sense of responsibility for the state of the environment and to teach students how to monitor, protect, and improve it" (p. 113).

Westing (1993) suggested that "All of the principal...blueprints for coping with the world's pervasive environmental predicament have stressed the value of [EE] (p. 5). Browner (1995) suggested that EE "is essential if Americans are to participate fully in solving environmental problems" (p. 7). The ICEE (1997) also concluded that EE "is important and should be taught in America's schools" and that EE "holds great promise for boosting the quality of learning in our classrooms" (p. 1).

Given comments such as these, it is not surprising that in its report to President Bill Clinton, the President's Council on Sustainable Development (PCSD) suggested that EE is evolving toward education for sustainability, which has "tremendous potential for increasing citizen awareness and the ability to engage in decisions affecting their lives" (PCSD, p. 57).

Much of the criticism of EE practice has, nevertheless, focused on its attention to changes in the affective and conative domains. While it is true that some, perhaps much, of the EE information presented is biased, and worse inaccurate, the notion that EE "would do better simply teaching about scientific matters, including hydrology, ecosystems and the weather" (Adler, 1993b, p. A14) contradicts the positions of the U.S. Department of Education's Office of Educational Research and Improvement, which suggested that "children need to develop good citizenship skills such as social responsibility, empathy, caring, and conscience" (USDOE, p. 8) and the position of the ICEE (1997), which suggested that

> engendering a stewardship ethic is clearly an appropriate goal for...education.... Environmental education...is a legitimate area of investigation for anyone who cares both about education and the future protection and sustainable use of our natural resources" (p. 5).

These positions are afforded tremendous support when the comments of The World Scientists', a group of nearly 1,600 scientists, including more than half of the living Nobel laureates, are considered. Their message included the position that

> Human beings and the natural world are on a collision course. Human activities inflict harsh and often irreversible damage on the environment and on critical resources. If not checked, many of our current practices put at risk the future that we wish for human society and the plant and animal kingdoms, and may so alter the living world that it will be unable to sustain life in the manner that we know. Fundamental changes [in behavior] are urgent if we are to avoid the collision our present course will bring (World Scientists, 1996, p. 242).

While desperate and passionate, such comments do not reflect a revelation. Twenty-three years earlier, Maloney and Ward (1973) suggested that the "ecological crisis is a crisis of maladaptive behavior...[and] the solution lies with the sciences that deal with changing human behavior" (p. 583).

Even more astounding is the fact that Osborn voiced a similar warning in 1948, when he argued that

> the present world-wide disturbances in human civilization can at least partially be accounted for by the havoc...that [humans are] working upon [their] natural environment. These disturbances will unquestionably increase in violence, even to the point of social disintegration, if the present velocity of destruction of the [E]arth's living resources continues (p. 30).

He went to suggest that humans have the

> power to remedy enough of the damage that [they have] caused to permit the survival of [their] civilization. The question is, Will [they] do it and will [they] do it in time? (p. 30).

Osborn further cautioned that no real solution to the environmental crisis will be found until there is a "complete revolution" in humanity's

> point of view toward the Earth's resources and toward the methods that it employees in drawing upon them (p. 47).

To me it seems entirely acceptable that EE research be concerned with modifying human behavior. Consequently, EE research should be expected to have as one of its foci, behavior modification. By behavior modification I mean educating learners:

- about the ecological foundations of environmental issues,
- about the human societal dimensions associated with said issues,
- how to investigate and evaluate environmental issues,
- how to take actions that are appropriate for their specific situation to become participants in the resolution of current environmental problems and the prevention of future ones,
- and how to teach others to do the same.

I do not mean behavior modification in a stimulus-response and/or operant conditioning sense. Some interested in EE research have, nevertheless, been quite vocal in their criticism of such a focus (see, for example, Wals & van der Leij, 1997 and Robottom & Hart, 1993), amazingly implying that such a practice might actually violate the concept of democracy (see specifically, Robottom & Hart, p. 36). Training learners to become active participants in the determination of their future is absolutely consistent with the concept of democracy. As I have already cited, both the Administrator of the EPA and the members of the President's Council on Sustainable Development have expressed precisely the same sentiment.

What Kind of EE Research is Needed?

Reports of EE research most commonly describe efforts using quantitative methods of inquiry (Marcinkowski, 1993, p. 56). However, reports of efforts using non-quantitative methods, while uncommon, are not completely absent. This may be because unlike positivisitc research reports, the reporting of non-quantitative research findings/results is difficult since there is no "well-codified, generally accepted protocol available as to how the methodology and findings" should be reported (Knafl & Howard, 1984, p. 17). Non-quantitative research should, nevertheless, "be evaluated on the same overall basis as other research, that is, according to whether it makes a substantive contribution to empirical knowledge and/or advances theory" (Ambert et al. p. 883). A con of EE research is that no guidelines for what is considered acceptable research, regardless of method of inquiry, are generally agreed upon by those conducting the research. This condition may be changing as I will discuss shortly.

> **". . . arguments about the 'goodness' of alternative paradigms [for research] simply must stop. The key to using any paradigm rests with the validity of the research itself and not which paradigm is used."**

The question of the appropriateness of method of inquiry regarding EE research was critically examined during a 1990 symposium on "Contesting Paradigms in [EE] Research" which was held at the annual conference of the North American Association for Environmental Education in San Antonio, Texas. *Alternative Paradigms in Environmental Education Research* followed the symposium. I will not repeat the efforts involved in producing the monograph. I recommend interested readers consult it for detailed discussions and analyses of EE research. I do, however, agree with Hungerford's (1996) admonition that, "arguments about the 'goodness' of alternative paradigms simply must stop. The key to using any paradigm rests with the validity of the research itself and not which paradigm is used." Again, I will have more on this shortly.

Gall, Borg and Gall (1996) suggest that education research contributes to four types of knowledge related to education:

- **description**, which involves knowledge about "natural or social phenomena -- their form, structure, activity, change over time, relationship to other phenomena..." (p. 4);
- **prediction**, which involves knowledge about "the ability to predict a phenomenon that will occur at time Y from information available at an earlier time X" (p. 5);
- **improvement**, which involves knowledge about "the effectiveness of interventions" (p. 6); and
- **explanation**, which is "the most important" knowledge includes the previous knowledge insofar as if "researchers are able to explain an educational phenomenon,...they can describe it,...predict its consequences, and know how to intervene to change those consequences" (p. 8).

Regardless of the research method of inquiry employed, these categories are easily defensible parameters for EE research.

Robottom and Hart (1993) critically analyzed the merits and demerits of positivism, postpositivism, interpretivism (constructivism), and critical theory paradigms regarding their potential to ease the "tensions" they suggest some believe exist regarding EE research; a tension they contend exists due to a paradigm bias among EE researchers. Again, I refer the reader to their work for detailed analysis of their thoughts. I also recommend interested readers visit Volume 2 of the *Canadian Journal of Environmental Education*, particularly the compositions by Wals and van der Leij, Roth, and McClaren for a very insightful discussion of the matter. I do, however, want to focus on one of their concerns. They suggested that a "shortcoming" of EE research concerns the "failure" to discuss "issues of EE research in light of debates that are occurring within the broader context of the field of education" (p. 5). Presumably, they were referring to the debates over the validity of the bipolar epistemologies that have appeared in many of the education research journals. I will offer more on this subject in the Research Designs Used section.

To address Gigliotti's concern regarding the identification of EE research questions, let me present the following. The Office of Educational Research and Improvement in the U.S. Department of Education (USDOE, 1997) unified its focus on educational research around five themes, including many recommendations for research that are appropriate for EE research:

> **supporting the learner**, that is, recognizing that students have personal characteristics, family backgrounds, etc. that must be recognized. Research in this area should focus on:
>
> - the development, implementation, use, and outcomes of educational innovations and use the findings to develop more effective educational models;
> - the development and evaluation of models of effective school-family communication and partnerships to promote student learning, especially for students from culturally diverse families and for students in early and upper grade levels
> - effective out-of-school learning settings, the principles which guide them, and sound ways of coordinating such learning opportunities with school programs;
> - the relationships between 'developmentally appropriate' and 'culturally appropriate' practices to identify best practices for building effective family-school partnerships;
> - the development of programs, services, and interventions that work best for given learners, under given circumstances;
> - the development of coping skills in learners to better succeed both in and out of school;
> - the development of instruction that supports motivation and persistence; and
> - the support mechanisms that contribute to the development of acceptable citizenship (p. 8).
>
> **improving teaching and learning**, citing that today's students "must learn more than in the past: more in-depth content, knowledge, better problem-solving strategies..." (p. vi). Research in this area should focus on:
>
> - determining which teaching practices under what conditions will work best for learners;
> - refining developmentally appropriate assessments and improving ways to administer these assessments;
> - improving understanding about individual and developmental differences among learners;
> - examining the similarities and differences in learning in different areas of the school curriculum, investigating the nature of informal 'out-of-school' learning and its relationship to classroom learning, and increasing understanding and management of social and motivational influences on learning;
> - the design of strategies needed to improve knowledge and skills in different content areas in a variety of settings, with students from a variety of ethnic and sociocultural backgrounds;

- technology as a tool for improved learning and on the development of quality, technology-based materials;

- interdisciplinary and interprofessional development programs that provide education providers with the skills, knowledge, and attitudes needed for successful collaboration with other educators, docent or formal;

- the design and evaluation of alternative teacher preparation strategies including their quality and effect on student achievement and development; and

- how to provide educators at all levels with professional development which aids in the acquisition of a deeper understanding of the subject matter, master teaching skills that work best with diverse learners, and change their beliefs about the characteristics of effective teaching (pp. 25-27).

strengthening schools, citing that today's schools "are expected to [do] far more than in the past" and that it is no longer acceptable to expect schools to merely "teach the basics to willing learners" (p. vi). Research in this area should focus on

- which approaches are generally most useful and work best in particular situations, and how they can be developed into practical applications that can be successful under a wide range of conditions;

- evaluating alternative approaches to creating effective learning communities in different types of schools, as well as studying ways to overcome barriers to their development; and

- evaluations of alternative methods of increasing learning time, including more effective use of existing time (pp. 41-42).

making the system work, citing that reforms, including the development and implementation of standards-based education, are occurring in many ways at all levels of government across the U.S. Research in this areas should focus on:

- how to spread successful reform across districts and schools;

- how to build both personal and institutional capacity and commitment for long-term successful reform;

- how to create a culture of learning and how to encourage and sustain it through the organization of a school and its surrounding community;

- identifying the knowledge and skills state personnel need to be sources of support and technical assistance rather than how states can provide incentives for local performance (pp. 50-51) and

improving postsecondary and adult learning, citing that "in the last several decades, changes in the economy, society, and polity have markedly altered the context within which postsecondary education operates" (p. vi). Research in this area should focus on:

- systematic assessments of the effectiveness of programs designed to provide better transition from school to work;

- the patterns of postsecondary access, participation, and economic returns;

- the development of better assessments of both student and institutional outcomes, including investigations that might link curricula content and a variety of outcomes including the personal, occupational, and civic skills of postsecondary students and graduates;

- identifying the skills and abilities needed for individuals to be effective lifelong learners; and

- the impact of low [ecological] literacy on the daily lives of citizens (pp. 60-61).

EE research designed to address these foci would likely make very positive contributions to the field. Even a casual consideration of these questions should illuminate the notion that no one method of inquiry is appropriate to answer all of them. For some of the questions, non-quantitative methods of inquiry may be most appropriate. For other questions, quantitative methods of inquiry may be most appropriate. To echo Hungerford (1996), it's not the method of inquiry that matters, its the quality, including recognition of the effect of the researcher's subjective bias on the study.

Robottom and Hart (1993) also offered the following research questions for a "critical approach" to EE research:

- How is environmental knowledge produced and reproduced in schools, and how is knowledge about EE reproduced in professional associations?
- What are the sources of the knowledge about the environment/issues acquired by students in schools, and what are the sources of knowledge about EE acquired by educators in professional associations?
- How do students and practitioners contest the kind of knowledge about the environment and EE that is conveyed through the lived experience of schools and professional associations?
- What impact do schools and professional associations have on students and environmental educators?
- Whose interests are being served by the perspectives and values immanent in the polices, organization, and practices of schools and professional associations active in EE?
- Are these served interests more consistent with emancipation, equity, and social justice, or with movements in the opposite direction?
- How can students and practitioners in EE be moved toward greater liberation, equity, and social justice? (p. 25).

These questions also provide guidance for EE research that would make a positive contribution to the field.

Considering the position of the USDOE and Robottom and Hart, two questions, the answers to which are vital to EE research and practice emerge:

- Has research knowledge influenced the practice of EE?
- If so, how has it influenced practice and learners?

One question deals with process while the other deals with outcome. The suggestion that "the point of [EE] is change; if there is no change there is no point" (Van Matre, 1993, p. 19) illustrates the purpose of the second question, namely the outcome or effect on learners. The suggestion that

> there is far too little known about what precedes or stimulates environmentally responsible behavior even though educational philosophers have written about it and a number of researchers have tried to investigate it (Hungerford, et. al., 1989, p. 1)

illuminates the lack of an adequate answer to both the first and second question as well as the need for continued research. But perhaps the most important EE research question is one identified by the PCSD:

> How should education for sustainability be transferred from conceptualization to practice? (p. 73).

We know quite a bit about what does precede environmentally responsible behavior, and there are examples of effective transferral of conceptualization to practice, but there is still much to be learned. As Hungerford (1997) has asserted, "there is an enormous amount of difficulty with EE research, but we must not throw out the baby with the bath water." To be sure, EE research has provided insights that have guided the field in a positive direction. These efforts must continue. For example, as Marcinkowski illuminates in another reading in this book, EE research has produced some real insights into the PCSD's question. Despite the contributions of the research efforts described by Marcinkowski, the methods of transferring conceptualiztion to practice remain in need of continued research. There are still some questions regarding environmentally responsible behavior that need answering. There is a fine foundation present. Now the challenge is to continue to build on that foundation.

There are four areas in which I believe EE research needs to advance. They include: 1) expansion of knowledge base; 2) research designs used; 3) instrumentation and instrument use; and 4) generalizability of findings.

Expansion of Knowledge Base

When I speak of expansion of knowledge base, I am considering several bases. One base involves knowledge about the life support systems of Earth. That is knowledge about the biological, chemical, ecological, geological, and physical systems that shape and guide the development of life on this planet.

Barely a day goes by when some new information about how the Earth operates and life on it survives is not discovered. Concepts once thought impossible, such a chemosynthesis and giant balls of ice from space adding to the water cycle on Earth, are becoming increasingly more evident and acknowledged. The various fields of scientific inquiry are continuously adding to our knowledge of Earth systems science.

Another base involves what educators know about the previous base. That is, how well do educators understand Earth systems and how prepared are they to teach others about them? Are they prepared to help learners make the connection between understanding Earth systems and economic, social, and political systems?

As Trefil (quoted in Pool, 1991) has suggested, "You have to know a field pretty well before you can teach it" (p. 251). Environmental educators have to understand a great deal about the fields of Earth sciences, sociology, psychology, economics, etc, as well as the education-oriented fields before they will be in a position to educate for sustainability. Without knowing what educators currently understand about topics in these disciplines, it will be difficult, if not impossible, to craft EE curricula that will address the goals of sustainability. Such information is also necessary for crafting preservice training as well as inservice continuing education. My own experience with inservice teachers is perhaps best illustrated by the comments of a biology teacher with 8 years experience, who confided in me at the conclusion of a course I recently taught on the ecological foundations of environmental issues, that he had only one ecology-type course in his entire education! My question is: Is he a typical or atypical representation of other inservice science teachers? What about non-science teachers? If EE is expected to be included as a component of all education, then non-science teachers would be expected to understand seminal concepts from the same fields.

This discussion reminds me of a scene from the movie *Teachers*. A teacher is lamenting to another teacher about the inability of one of her students to read. The actor Richard Mulligan, playing a mentally disturbed person who happens to be masquerading as a substitute teacher, is listening to the conversation. His advice to the teacher is: "How about teaching him to read?" To this the teacher responds, "I am a social studies teacher, it is not my responsibility to teach him to read." Mulligan replies, " Ah, but you are a teacher!" Even Hollywood can imagine a situation in which any teacher, regardless of academic preparation or subject matter specialization, can teach a learner how to read. If EE is truly education for ecological sustainability, then every teacher should, perhaps must, be prepared to assist learners in acquiring the knowledge, skills, abilities, and experiences that will permit them to mature and live their lives in ways that are compatible with ecologically sustainability.

More research is needed concerning educators' ecological literacy as well as how best to produce ecologically literate educators.

Another base involves what learners know about the Earth systems. That is, what are the naive concepts or misconceptions they may bring to a learning situation? What accurate concepts or conceptions do they bring? In many instances, educators need to know what learners currently understand in order to effectively educate them regarding what they should understand.

Munson (1994) examined misconceptions about ecology and concluded that

> people hold misconceptions that strike at the heart of a general understanding of ecology. The existence of [these] misconceptions poses a serious problem for environmental educators (p. 34).

He recommended that more

> research needs to be published that identifies the common ecological misconceptions that may interfere with [EE] efforts (p. 34).

As I have already indicated, in reports of barriers to environmental education, teacher respondents have reported lack of knowledge about the environment and/or environmental issues as a major reason why they do not incorporate EE concepts into their teaching (see, for example, Lane, Wilke, Champeau, & Sivek, 1994 and Smith-Sebasto &

Smith, 1997). More research is needed concerning educators' ecological literacy as well as how best to produce ecologically literate educators.

Another base involves the techniques of transferring information about Earth systems and about environmentally responsible (ecologically sustainable) behavior adoption from educators to learners. That is, what is the best way to teach learners about Earth systems and/or about behavior adoption or modification. Are the theories and practices for education in other disciplines appropriate for EE concepts, or are EE concepts in some way unique regarding how best to ensure comprehension of the information?

EE simply cannot, and should not, tolerate the development of educational materials whose impact on the learner is unknown. For all we know . . . comic books may be the best way to educate young learners about the environment. That we have no insights into this question should be absolutely intolerable . . ..

Recent work regarding virtual reality (Taylor & Disinger, 1997) is one example of the type of investigations that are needed. I am not advocating the use of virtual reality in EE, but it does warrant careful investigation. Another example involves efforts by the Soil and Water Conservation Society, the National Association of Conservation Districts and others who produce comic books that deal with environmental issues. The question one may ask is whether comic books are an effective manner to teach about the environment and/or environmental issues. There is a paucity of research findings available that address such a question. EE simply cannot, and should not, tolerate the development of educational materials whose impact on the learner is unknown. For all we know the comic books may be the best way to educate young learners about the environment. That we have no insights into this question should be absolutely intolerable, if not from an educational perspective, then from an economic perspective. With funding for education already low, money should not be invested into the development of educational materials that have unknown effects on learners. Any educational material, be it a book, videotape, CD-ROM, software, etc. must include a research component that includes both formative and summative evaluation.

Some advance has been made on some of the knowledge of some of these bases. For example, it was EE research that identified environmental sensitivity, perceived knowledge of and skill at performing environmental protection action strategies, and locus of control for reinforcement (LOCR) as predictor variables for performance of environmentally responsible behavior. To follow Hungerford's metaphor about a baby's bath water, however, I suggest we must not rest on our laurels. For example, the psychological constructs locus of causality for behavior (see, for example, deCharms, 1968, 1981) and need for control (see Korteland, 1989) seem ripe for research on predictors and/or antecedents of environmentally responsible behavior, yet remain virtually uninvestigated. In fact, even in *Research in Environmental Education* 1981-1990 (Marcinkowski & Mrazek, 1996), only LOCR is identified as a descriptor. Over-reliance on LOCR in research on environmentally responsible behavior simply because previous studies have indicated a relationship limits this knowledge base. Research on other variables, such as those mentioned, needs to be pursued as aggressively as was the research on LOCR. Additionally, the model of long-term and repeated research efforts such as those described by Marcinkowski in a separate reading in this book must continue and be expanded to other dimensions of EE. There is, after all, a lot we know about antecedents to performance of environmentally responsible behavior, but there is still a lot left unexplained.

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Research Designs Used

Campbell and Stanley (1966) provided what is considered by many to be a definitive guide for quasi- and experimental research (although their guidelines can also be employed for studies using non-experimental methods). In it they outline the merits and demerits for a variety of research designs. I am frequently confused as to why research designs more resistant to threats to validity are not employed. For example, many studies employ the Pretest-Posttest Control Group Design. Employ-

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ing the Solomon Four Group Design requires very little extra effort (administering the pretest to half of the sample rather than all of the sample), yet I have reviewed or read in print very few research reports employing this design despite Campbell and Stanley's suggestion that it "has higher prestige" (p. 24).

I am equally confused concerning why the quantitative method of inquiry so predominates what I read in journals and/or review. As a student, I was taught that the quantitative methods of inquiry are best suited to test null hypotheses, while non-quantitative methods of inquiry are best suited to identify research questions and/or hypotheses. Often, too often, I find myself reading a report of research in which I can find no defensible explanation for the origin of the research questions or hypotheses.

The question, according to Mrazek (1993) is: "are we dealing with replacement of paradigms in [EE] research or coexistence of multiple paradigms?" (p. 11). Disinger (1993) stated that he does not

> believe that [the field of EE] currently [has] an initial paradigm, or a set of competing or alternative paradigms for [EE] research.

The field, he suggested, does

> have a number of research 'patterns, examples, models'...[which are used for several reasons], one of which is that [the field does] not have [its] own. Another is that most environmental educators have themselves come from other fields, and bring the research patterns and traditions of those fields with them. Yet a third is that, [for many EE researchers, their] professional identities remain tied to those other fields, so [they] feel and perhaps are compelled to maintain identity with them. Thus we may be practicing 'environmental education,' but we are professionally obligated to practice it in the context of 'something else,' for example, "there is pressure in the science education community to use the research [paradigms] of the natural sciences, as opposed to the behavioral sciences (pp. 20-21).

Quoting Schulman, Marcinkowski (1993) argued that

> we must avoid becoming education researchers slavishly committed to some particular method....We must first understand [the] problem, and decide what questions [need to be answered or hypotheses need to be investigated], then select the mode of disciplined inquiry most appropriate to those questions [or hypotheses] (p. 46).

Disinger's (1993) suggestion that it may be "overly ambitious and potentially dangerous, to attempt to define a unique research paradigm" for EE (p. 22) is an excellent progression from Schulman's admonition.

This forces me back to a discussion regarding the debate about the inferiority/superiority of one method of inquiry over another. Let me repeat Hungerford's admonition: "arguments about the 'goodness' of alternative paradigms simply must stop. The key to using any paradigm rests with the validity of the research itself and not which paradigm is used." My reason for returning to this topic stems from some comments made during an all-day seminar on EE research that Rick Mrazek and I offered during the 26th Annual Conference of the North American Association for Environmental Education. Our motive for offering the seminar was to introduce guidelines for conducting and reporting EE research. We recognized that the guidelines for both quantitative and non-quantitative research were flawed. We felt, nevertheless, that engaging in a dialogue would be the best method to facilitate the development of a set of guidelines that would advance the efforts of EE scholars.

At the beginning of the conference seminar, it was suggested by one participant that offering guidelines for research was premature, even irresponsible, in light of the fact that we have not satisfactorily answered the question "What is research?" Additionally, some in the room seemed more concerned about arguing the superiority of one method of inquiry (more accurately, the rejection of one method of inquiry) over another. They seemed, in a sense, to be more interested in arguing that the way EE research is conducted is based on a flawed mythology, much as the gorilla in Quinn's *Ishmael* argues that human development is based on a flawed mythology. This position, I believe, is not going to advance the field. It is simply not an 'either/or' condition. Instead of dwelling on the differences in the methods of inquiry, I believe it would be far more productive to explore how the competing methods of inquiry can be employed collaboratively and cooperatively to more completely explore the issues facing EE as well as society's challenge to develop in an ecologically sustainable manner.

> **It is simply not an 'either/or' condition. Instead of dwelling on the differences in the methods of inquiry, I believe it would be far more productive to explore how the competing methods of inquiry can be employed collaboratively and cooperatively to more completely explore the issues facing EE as well as society's challenge to develop in an ecologically sustainable manner.**

Furthermore, after much thought, my response to the suggestion that offering guidelines for research is irresponsible is: For millennia philosophers and theologians have wrestled with the question "What is the meaning of life?" Even the U.S. Supreme Court has had to address the question "What is life?" regarding the issue of abortion. Even without a universally accepted answer to the "What is the meaning of life" question, virtually every society and/or religion has crafted its own set of guidelines for the conduct of life. Societies have even composed laws to deter violation of these guidelines. Clearly, the masses of the respective societies or religions adhere to the appropriate guidelines even without an answer to the fundamental question.

Equally clear, is that no one society has crafted a set of guidelines for life that fit all other societies. What is taboo in some societies, for example, is barely noticed in others. This does not mean, however, that different societies must reject or consider inferior other societies' guidelines for life. My point is that some guidelines for research are better than none. That the guidelines are imperfect may simply be a condition of the human species. People do the best with what they have. Societies have gone to war and killed each other because of differences of opinion concerning guidelines for life. EE researchers should not resort to such animosity regarding methods of inquiry.

Why, I ask, is it so intolerable to some to suggest that EE researchers be presented with a set of guidelines? I doubt any EE researcher will ever design a perfect study or produce a perfect report of findings. Such researchers must attempt to do the best they can with what they have. An agreed upon set of guidelines for conduct and reporting of research, regardless of the 'paradigm', that represent the best guidance currently available, and that are subject to regular review and revisions, should be valuable to the field. Happily, I can announce that some of the participants in the seminar attempted such an effort. A draft document containing guidelines for conducting and reporting non-quantitative EE research was composed.

Unfortunately, time did not permit the development of a set of guidelines for quantitative research, although tremendous interest in such a effort was expressed by nearly all in attendance at the seminar. There are, however, published guidelines for conducting quantitative research (see, for example, Gall, Borg, and Gall, 1996, pp. 741-44). What is needed now is feedback from the EE research community at-large regarding the validity of the proposed guidelines. This represents both pros and cons of EE research. On the pro side is the fact that so many participants, often from diametrically opposed points-of-view, attended the research seminar, attempted to put their philosophical differences aside, and were involved with the crafting of the guidelines. The con to that is that many involved in EE research were not participants in the seminar. Another pro is that the guidelines are being made public in this document (as an Appendix) for feedback from others. The con will be if others do not provide said feedback. Perhaps the most important pro is the evidence that the number of people interested in EE research, including identifying guidelines to improve its quality, is increasing.

This level of understanding of the research process should be an essential element or condition of the training of new EE researchers and the philosophy of experienced researchers.

Instrumentation and Instrument Use

One of the most serious research limitations and/or liabilities I see in much of what I review for publication and/or read in print involves survey research efforts. Much of what is reported in the EE literature represents either quantitative psycho- or sociometric research. That is, people are asked to indicate their knowledge, attitudes, and/or behaviors related to some aspect of an environmental issue(s). As such, the data generated by the measurement instrument used to ascertain said knowledge, attitudes, or behaviors is sublime. More correctly, the reliability and validity of the data generated via the instruments or subjects is sublime. Unfortunately, rarely do I find evidence in a research report of either. Instead, I read comments such as: "...reported that all classes exposed to the boxes showed significant changes in knowledge" (Roy, Petty, and Durgin, 1997, p. 10, citing an unpublished M.S. thesis, leaving the reader to have to acquire the thesis and read it to determine if the data were reliable and valid).

At this point some discussion of reliability and validity is appropriate. Since so much of the EE research submitted for publication consideration that I have reviewed as well as that which is actually reported in the journals represents either quantitative psycho- or sociological research or quasi-experimental research, I am going to focus this discussion on those types of research. This represents no particular bias on my part. Instead it recognizes the need to immediately address the quality of what constitutes the majority of the EE research being conducted and reported. There are times for philosophizing and times for pragmatism. This discussion happens to fall to the later and should not be interpreted as suggesting an inferiority of efforts in the former.

Traditionally, reliability has come to refer to the degree to which the scores derived on a given administration of a test, or responses derived on an interview, for example, would resemble scores on the same test administered to the same subjects at some later time or responses to an interview at some later time. In other words, temporal stability. It has also come to mean the degree to which items within a test are related to one another, or internal consistency (Crano & Brewer, 1973).

Validity is "an integrated evaluative judgment of the degree to which empirical evidence and theoretical rationales support the adequacy and appropriateness of inferences and actions based on test scores or other modes of assessment" (Messick, 1989, p. 13). Put another way, validity is the "extent of correspondence between variations in scores on [an] instrument and variation among the respondents on [an] underlying attribute under investigation" (Crano & Brewer, 1973, p. 249).

Data validity has been separated into three different types (Ary, Jacobs, and Razavieh, 1996, pp. 262-273):

Content validity, which is based on the assumptions of the researcher. There is no statistical index of content validity. Content-related validity is "established by showing that the [instrument] items are a sample of the universe in which the investigator is interested. [It] is ordinarily...established deductively, by defining a universe of items and sampling systematically within this universe to establish" the instrument (Cronbach and Meehl, 1955, p. 282). It provides "judgmental evidence in support of the domain relevance and representativeness of the content of the test instrument, rather than evidence in support of inferences to be made from test scores" (Messick, 1989, p. 17). Evidence for content-related validity "is gathered by careful and critical examination by expert judges of the test's content" (Ary, Jacobs, & Razavieh, 1996, p. 263).

Criterion validity, which is "evaluated by comparing test scores with one or more external variables (called criteria) considered to provide a direct measure of the characteristic of behavior in question" (Messick, 1989, p. 16). Two distinctions with the rubric of criterion-related validity are generally accepted: predictive validity and concurrent validity, although convergent validity is also recognized. Concurrent validity concerns "the correlation between test scores and a criterion measure available at the same time" (Ary, Jacobs & Razavieh, 1996, p. 268). Predictive validity concerns "the correlation between test scores and a criterion that occurs at a future time" (Ary, Jacobs & Razavieh, 1996, p. 268). Campbell & Fiske (1959) suggested convergent validity, or the "confirmation" of data "by independent measurement procedures," that is, using different instruments designed to measure the same criterion (with the expectation of high correlation between the two data sets), as another form of criterion-related validity.

Construct validity, which is the most comprehensive type of validity in that both content- and criterion-related validity evidence have come to be recognized as aspects of it (Messick, 1989), refers to the extent to which a test measures a specific trait or construct (Ary, Jacobs, & Razavieh, 1996). In assessing construct-related validity, an investigator seeks to determine the degree to which an individual possesses some trait or quality presumed to be reflected by a respondent's score on a test (Messick, 1989). It "must be investigated whenever no criterion or universe of content is accepted as entirely adequate to define the quality to be measured" (Cronbach & Meehl, 1955, p. 282).

There is no single method which an investigator can employ in an effort to establish construct-related validity of data. In addition to correlation with other measures, as mentioned previously, however, there are additional methods available to assess this type of validity. For example, known group differences involve the use of two groups: one which is assumed, with a high degree of confidence, to possess the trait in question, and one which is either unknown or known to hold opposite orientations of the trait in question to the other group. A construct-related valid test should be able to discriminate between the two groups. Additionally, in a experimental manipulation situation, in which some treatment is expected to produce changes in subjects, a construct-related valid test should be able to detect said changes.

Campbell & Fiske (1959) suggested that construct-related validity could be evaluated by assessing discriminant validity of the data by administering two different instruments designed to measure two different criterion, with the expectation that the two data sets would not be significantly correlated, that is that the data would not be too highly correlated with data from which they were intended to differ.

I have received requests for copies of the Environmental Action Internal Control Index (EAICI), which I developed as part of the requirements for my Ph.D. from Australia, England, Greece, Italy, Korea, and Taiwan in addition to requests from U.S. investigators. The requests are usually in the form of "I read your article in *JEE* and would like to use your instrument in my study. Please send me a copy or let me know how I can get one." With each reply, I send the same caution: these instruments were designed over 5 years ago with a sample of U.S. students. As such the data generated with your sample may not be reliable and valid. I urge you to assess both the reliability and validity of the data obtained in your study. While it is flattering that my instrument has received such a response, it will do the field of EE no good at all if it is used with reckless abandon. In a world where an atomic clock is adjusted to billionths of a second, I don't believe its too much to require that psycho- and/or sociometric instruments be 'calibrated' frequently and that such 'calibrations' be accepted as scholarly EE research. This leads me to my final concern.

Generalizability of Findings

One of the most serious concerns I have regarding EE research involves generalizing findings beyond that which is possible. For example, since the publication of their article "Barriers to Environmental Education" Sam Ham and Daphne Sewing (1987-88) have been cited in virtually every study that addresses EE success or failure. I mean absolutely no disrespect to Dr. Ham or Ms. Sewing. Their work was of great importance to the field. To cite it, however, as if some universal understanding about the barriers to EE have been discovered is a serious mistake. In many instances in which I have encountered a reference to their publication, it is the only reference that addresses the concept of barriers. Additionally, in many instances the author(s) cite their work in the context of: these are the barriers to EE, without so much a suggesting the existence of other possible barriers. To presume that one very small sample of teachers from one region of one state is reflective of teachers nationwide is alarming, not to mention ill-advised.

One of the most serious concerns . . . regarding EE research involves generalizing findings beyond that which is possible.

The condition is so serious, that when I review a manuscript or read an article, I can almost anticipate which studies will be cited, regardless of their age or scholarship. That is, current EE research seems to be built on the same base of past research. That is not necessarily bad, since one of the fundamental aspects of science is replication. What is concerning, however, is the lack of innovation or diversity in the cited literature. In many instances, research in EE seems to be stuck in a state of stasis so far as referencing is concerned.

I recognize and acknowledge that the psycho- and sociological aspects of EE research make it particularly vulnerable to the type of liability I have just identified. The human animal is not only complex, but it is extremely difficult to study for reasons that include the fact that it is incredibly dynamic, changing constantly.

EE is probably not a "one size fits all" endeavor. That is, EE that is successful in one setting under certain circumstances, with certain educators, and certain learners, may well be completely unsuccessful in other situations. This has certainly be demonstrated in other disciplines. There is like-

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ly no reason to presume the situation will be different for EE. Consequently, researchers must begin replicating studies more often, and journal editors must recognize the value of such efforts and accept such reports, so long as they meet the standards of academic scholarship, for publication. With enough replications, confidence of findings will increase, but at present, there are painfully too few corroborating research efforts or reports.

Conclusion

If humanity and nature are indeed on a collision course and if the attendant environmental crisis is the result of human behavior, then it is logical to posit that changes in human behavior are necessary to avoid the negative repercussions that will likely follow. It is, therefore, logical to look to education for impetus for the needed changes. Indeed, that is precisely what many have suggested is the role of EE. If EE is to fulfill this role, it must be guided by research that clearly identifies the areas of need as well as the most appropriate direction for progress. Rather than debate paradigms, I believe it is essential for researchers to fix their sights on the seminal questions surrounding ecologically sustainable development and to pursue them with extreme prejudice and with the most appropriate research methodologies to answer the questions.

The seminal questions I think need to be addressed include:

> 1. Is the current model of human industrial development ecologically sustainable? That is, are the current models societies are using to either advance their industrial processes or to develop an industrial base compatible with the life support systems of the planet?

If the answer is no, as many believe it is, then EE does, indeed, have a reason to exist. The key question then becomes:

> 2. What, precisely, is it about the models of industrial development that are not ecologically sustainable?

Before educational interventions can be prescribed, a diagnosis must be made. Observation of symptoms will sometimes be sufficient. However, such cursory assessments will frequently be rejected until more tangible evidence is available. The key question then becomes:

> 3. What, precisely, do learners need to know in order to make the shift from ecologically unsustainable behaviors to ecologically sustainable behaviors?

The specific needed changes in knowledge, attitudes, and behaviors must be identified before educational interventions can be developed. These changes must be related directly to the quest for ecological sustainability. Change for the sake of change will not likely result in any benefits to society. Now, the question for EE researchers is:

> 4. What is the most effective strategy to maximize the likelihood that the educational effort will produce the desired change?

Unlike in Kevin Costner's *Field of Dreams*, EE is not a 'create it and they will teach it" or a 'teach it and they will learn it' situation. EE curriculum may be created, and teachers may teach it, but learners may not learn 'it'. It is imperative that EE research efforts directed at formative and summative evaluation of curriculum intensify. The field (some argue society) cannot afford to squander teachable moments. Not only is a mind a terrible thing to waste, an educational opportunity is also a terrible thing to waste.

To paraphrase a line from U. S. President Bill Clinton, I believe the best of environmental education is yet to come. This includes the best of EE research. I believe the field has endured a prolonged infancy regarding research efforts, but I have begun to detect some signs of change. For example, the fact that the North American Commission on Environmental Education Research even exists is evidence of recognition of the importance of EE research. Additionally, at the 25th and 26th Annual Conference of the North American Association for Environmental Education many of the Consulting and Executive Editors of *JEE* met to discuss *JEE*'s role in the reporting of EE research. Much as children enter growth spurts -- often detectable by even subtle changes -- during which caregivers are endlessly amazed at the speed with which the child can grow and mature, so, too, can EE researchers amaze critics and supporters alike with the speed with which the research base in the field can mature. I believe there has been adequate discussion of research needs and methodologies to provide more than enough guidance and support for the growth I believe is possible. Nevertheless, much as Fairfield Osborn asked 50 years ago concerning environmental protection, I ask: Will EE scholars respond to the guidance and support for growth and improvement in EE research and will they respond in time?

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Appendix

Guidelines for Conducting and Reporting Non-Quantitative EE Research

A. Introductory Section

1. Has the researcher(s) adequately described how the research problems, procedures, or outcomes were shaped by her/his institutional affiliations, beliefs, values, or theoretical orientation?
2. Is the literature cited relevant and sufficiently representative?

B. Research Procedures

1. Was the choice of cases or research participants appropriate for the intended research?
2. Was there sufficient depth of data collection?
3. Has the researcher(s) adequately ensured credibility and trustworthiness of the data?
4. Is the context of the research (e.g. historical, cultural, etc.) adequately described?
5. Has the researcher(s) adequately described the rationale for the selection of the specific research procedure?
6. Has the researcher(s) adequately addressed the ethical considerations related to the research purpose?

C. Research Outcomes

1. Did the researcher(s) provide sufficiently detailed information about the data to permit interpretation?
2. Has the researcher(s) adequately described the relationship between the data and the outcomes?
3. Has the research adequately described the evolving relationship between the emerging research questions and data?
4. Were the appropriate data analysis techniques used and were they described adequately?

D. Discussion

1. Has the researcher(s) offered a reasonable interpretation of the outcomes?
2. Did the researcher(s) draw reasonable implications of the outcomes for the research participants or other audiences?

E. General

1. Did the researcher(s) demonstrate consistency between A1 and the research design, data collection, and interpretation?

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One Fifth Grade Teacher's Story:
Extended Case Studies Focused on Municipal Solid Waste*

*"**The 1990-91 School Year:** During the first semester, the fifth graders became concerned about the amount of Styrofoam and plastic products used in the school cafeteria. Students wrote letters to the superintendent and kept daily counts of items used by the 5th graders only. At Christmas, the class and I decorated our tree with plastic and Styrofoam from one day's throw aways for one 5th grade classroom. We ttook a picture, enlarged it, sent it to the superintendent. After the first of the year the students made a 3-D chart listing the amount of plastic & Styrofoam used in the cafeteria. This was presented to the superintendent at the end of the year. During the discussions in class about the use of these materials, one student decided she would ask for her food directly on her tray. She was first in line and the cafeteria workers became very upset. I had administrative visitors before the day was over. Although the students and I created quite a stir and made some people angry, the following school year food was served on trays and in washable dishes.*

***The 1991-92 School Year:** Concern was voiced because of new Missouri law stating that no yard waste can be thrown in with the municipal solid waste. Students wrote letters to local public officials in the late fall expressing their concern as to how to dispose of real Christmas trees. They received recognition on the local radio station and in the newspaper. Officials took their letters to the following board meeting and the city rented a wood chipper for the month of January. The city officials - save one - responded to the students.*

***The 1992-93 School Year:** An organization came in to the community with the intention of building a landfill on land they had purchased from an elderly lady. The group led the lady to believe they were going to build a lake development and therefore needed soil samples. The community was very distressed over this. Groups were asked to make posters. School officials said - "no participation"! We didn't participate. We had a T shirt logo contest instead. This contest received a big newspaper write up, but we didn't make posters.*

***The 1995-96 School Year:** My students circulated a questionnaire on interest in recycling . . . how far people would travel to a center . . . if they would only recycle curbside. We presented these results on our local public access TV and not long after that a local elected county official began looking into a recycling center. We will never know if the city was encouraged to act because of our results. But, we now have a recycling center and before it ever opened the head person called and asked for my assistance.*

***1997:** My class is now collecting scrap paper from all the classrooms in our building as a continuation of a recycling project started last year. Our PTA president comes in and helps take the scrap paper to the center for us."*

* *- These anecdotes were communicated to Dr. Hungerford, at his request, by Delores Roth, a Fifth Grade Teacher in Ste. Genevieve, Missouri. Delores was asked to restrict her responses only to those years in which her students became involved in some way with solid waste. These are her stories! It would also be proper to also note that, in 1994, Delores was selected as one of the top three elementary science teachers in the state of Missouri.*

As told to Dr. Hungerford by Ms. Delores Roth
of Ste. Genevieve, Missouri, September 1997.

Environmental Education and Environmental Interpretation: The Relationships

Doug Knapp

In this article Dr. Knapp takes the reader into a thorough discussion of the relationships that exist between environmental interpretation and environmental education. The similarities and the differences are important to both endeavors. More important, perhaps, is the notion that the two fields are perfectly compatible and that cooperative ventures are highly recommended. In this vein, examples are given which invite the reader to consider similar projects/programs.

Note: *In this reading Dr. Knapp talks a great deal about "behavior change." Lest there be misinterpretation of this phrase, Dr Knapp is discussing changing an individual's actions with respect to responsible citizenship. This is not to be interpreted as an aspect of behavioral modification in the traditional Skinnerian sense.*

Introduction

In 1957 Freeman Tilden wrote a seminal publication entitled *Interpreting Our Heritage*. Thirteen years later the country celebrated its first Earth Day to mark the importance of our planet and the fragility of its biosphere. These events marked the contemporary arrival of environmental interpretation and environmental education respectively. For the past twenty years both of these fields have, for better or worse, been looked upon as similar in outcomes and structure. Certainly, many have used these terms interchangeably.

Despite a similar mission of creating an environmental ethic, both of these specialties have their own unique characteristics. This reading will attempt to highlight variables that set environmental interpretation apart from environmental education. Strategies to create successful connections between the two fields will be reviewed along with ways to promote these relationships.

Interpretation, environmental interpretation, nature interpretation, nature study and environmental education are all terms that have commonalties. Some of these fields have come onto the scene in part due to social influences. For example, the advent of environmental education has its roots in events such as the Santa Barbara oil spill and the first Earth Day in 1970. To many, the assimilation of terms like environmental education and interpretation were justifiable. Many believe that there is no need to create discrete categories for these terms. Today many books, relevant articles and government agencies use the terms environmental interpretation and environmental education interchangeably (Carson & Knudson, 1996; Comish, 1995; Ham, 1992).

However, the lack of distinction between environmental education and interpretation is detrimental to both fields. Each is a unique endeavor that can make its own impact on its particular audience. As Zuefle states: "Interpreters can educate and educators can interpret. Some folks can do both ... But there are differences. Perhaps interpreters need to reexamine those differences. After all, without a

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Environmental education enhances critical-thinking, problem-solving, and effective decision-making skills. It also teaches individuals to weigh various sides of an environmental issue to make informed and responsible decisions. Environmental education does not advocate a particular viewpoint or course of action.

clear understanding of the work to be done, how can we possibly go about doing it?" (Zuefle, 1997, p.6). It is, therefore, important to distinguish the similarities and highlight the differences of both.

A Similar Mission

The outcomes desired by interpreters are similar to the directives of environmental education. The current definition of environmental education offered by the Environmental Protection Agency can be closely linked with the behavior change goals of many interpreters:

> Environmental education enhances critical-thinking, problem-solving, and effective decision-making skills. It also teaches individuals to weigh various sides of an environmental issue to make informed and responsible decisions. Environmental education does not advocate a particular viewpoint or course of action. (Federal Register, Tuesday, December 10, 1996, p. 65106)

The similarities in outcomes have led many to believe that environmental education and environmental interpretation are virtually one in the same (Hammitt, 1981; Mullins, 1984; Sharpe, 1982). Mullins expresses the perceived similarities between the two fields:

> The major differences between formal environmental education and interpretation lies in the premise that formal education is a societal approved sanctioning system in which participants are required to learn and demonstrate certain competencies. Interpretation often uses the same messages, with the same media, in similar outdoor settings. (Mullins, 1984, p. 1)

Sharpe is more explicit in stating, "Separating interpretation from environmental education is difficult" (1982, p. 25).

Important Differences

Although the ultimate aim of environmental interpretation and environmental education may be similar, the inherent nature of both fields create three clear contrasts. First, the structure/characteristics of both are different. Environmental education tends to be associated with formal institutions that require students to participate in a sequential learning process. Interpre-tation, on the other hand, tends to be voluntary and located in recreational settings. Most interpretive experiences, at best, cover a period of two hours to half a day. As Gail Vander Stoep explains, "Typically [interpretation] occurs in settings that are informal or nonformal; target audiences are voluntary; the interpretive experience is usually short term (single, standalone experiences) rather than part of a series over an extended period" (1995, p. 470). On the other hand, curriculum development in environmental education is based on the premise that a student becomes invested in environmental issues (Hungerford & Volk, 1990). This variable is predicated on a period of time longer than the average interpretive experience can offer.

The lack of time with constituents creates a significant gap in attaining the behavior change goal associated with both environmental interpretation and environmental education. Several research studies regarding environmental behavior list important variables associated with this desired change. Two of the most crucial variables are an individual's in-depth knowledge of environmental issues along with an investment of time regarding these issues (Borden & Powell, 1983; Hines, Hungerford, & Tomera, 1987; Holt, 1988; Hungerford & Volk, 1990; Marcinkowski, 1989; Sia, Hungerford, & Tomera, 1986). People need time to attain the sensitivity, knowledge and attitudes necessary for a positive environmental ethic. Time is certainly one characteristic that an interpretive experience lacks.

A second important contrast with environmental education is interpretation's lack of credible program development goals associated with behavior change. For the past 20 years the field of environmental education has been guided by a set of established principles. These guideposts (the Tbilisi Declaration) were produced at an international environmental conference in 1977 and consisted of a series of hierarchical learning objectives. The Tbilisi Principles have been the foundation for the development of several theoretical models in environmental education. These directives have laid the groundwork for research and development in theoretical and action-based models that have produced several reputable environmental curricula (Disinger, 1993).

Environmental interpretation, on the other hand, is based on six principles written by Freeman Tilden forty years ago. Although his principles are important directives, the field has not developed a 'road map' to achieve some of his attitudinal/ behavior change goals. The interpretive field has offered only a handful of untested theoretical models on which to base methodology. In 1986 Cable, Knudson, and Theobold suggested the use of Fishbein's Model of Reasoned Action to aid interpretive experiences in "attitude changes and action modification"(p.21). Other leaders have utilized theories based on Kohlberg, Maslow, and Piaget to develop interpretive experiences for children. The author has also developed a behavior change model based on research in the environmental education field (Knapp, 1994). These and other paradigms must be tested to help the field of interpretation in its behavior change objectives.

A third point that reinforces the distinction between environmental education and environmental interpretation is the current research findings. Analysis in environmental interpretation has produced two major conclusions. First, interpretation can increase the acquisition of knowledge regarding ecology and other basic information pertaining to a resource site (Koran, Koran & Ellis, 1989; Lisowski & Disinger, 1988; Ramey, Walberg & Walberg, 1994). Programs offering content that involved basic awareness and information of a resource site can improve the knowledge of a visitor (Drake & Knapp, 1994; Knapp & Barrie, 1995). Second, interpretation has a more difficult time in proving its impact on attitude and behavior change (Cable, Knudson, & Theobald, 1986; Gramann & Vander Stoep, 1987; Roggenbuck, Hammitt & Berrier, 1982). It is difficult to find evidence that a short term interpretive experience can create the steward or preservationist that the profession desires (Knapp, 1996).

It is difficult to find evidence that a short term interpretive experience can create the steward or preservationist that the profession desires.

In contrast, research in the field of environmental education has produced considerable data that show it can impact an individual's attitude and behavior toward the environment. Although there has not been found to be one pervasive paradigm, there has been solid fundamental headway taken by several leaders in environmental education. As John Disinger describes it:

> A good deal of effort has gone into the development of prospective paradigms for research in environmental education. ...Over two decades Hungerford and his associates have refined this concept by organizing and conducting a series of focused research studies dealing with education for the development of responsible environmental behavior. They have established a functional model with a viable research pattern and consistent examples. Another candidate for 'potential paradigm for environmental education research' is action research. It too has become established as a useful and productive model. (In: Mrazek, 1993, p. 23-24.)

The inherent structural differences between the two fields and the lack of research-based program development goals for interpretation give support to the notion that an interpretive experience should be considered an aspect of environmental education and not environmental education itself.

Interpretation is an Aspect of Environmental Education

The inherent structural differences between the two fields and the lack of research-based program development goals for interpretation give support to the notion that an interpretive experience should be considered an aspect of environmental education and not environmental education itself. Interpretation does not achieve the ultimate goal of environmental education. Despite our best efforts, a two hour interpretive experience does not accomplish behavior change in an individual regarding his/her actions toward the environment. On the other hand, an interpretive experience can be an essential and successful aid in achieving this behavior change goal.

Although many in the field may not find this conclusion surprising, there are those from the past and present that believe that, somehow, interpretive experiences could change behavior (Bixler, 1991; Mullins, 1984; National Park Service, 1992; Risk, 1992; Sharpe, 1982; Tilden, 1957). Statements such as the one made below characterize this lofty expectation:

> Interpretation must not only fulfill the aspirations of conservationists but also should act as a major force for the social, economic, political, and cultural good. Interpretation should encourage and motivate individuals and groups to participate in decisions concerning alternative futures and appeal to people at an affective as well as a cognitive level. (Ballantyne & Uzzell, 1993)

This type of rhetoric regarding the hopeful outcomes of an interpretive experience can be detrimental to the actual constructive influences our specialty can accomplish. This is not to say that interpreters must not heed Tilden's call to provoke, but they should be pragmatic in their quest and understand that the most successful tactic to achieve behavior change may lie in the establishment of partnerships with the longer term process of environmental education.

Making the Connections

The differences between environmental interpretation and environmental education are outlined not to place the importance of one above the other. Instead, it is to attempt to investigate optimum connections between the two to promote the terminal goal of both. In particular, the interpretive field must begin to find new and better ways to combine efforts with environmental education. The similarities between both environmental education and interpretation necessitate that the success of either is predicated on the development of partnerships.

The differences between environmental interpretation and environmental education are outlined not to place the importance of one above the other. Instead, it is [an] attempt to investigate optimum connections between the two to promote the terminal goal of both. In particular, the interpretive field must begin to find new and better ways to combine efforts with environmental education.

Future trends in interpretation must avoid isolated experiences that answer a teacher's need for that once a year 'nature trip'. This will require partnerships with other local interpretive programs. "Packaged" interpretive experiences that include visits to a variety of sites during a school year could increase the power of the educational message and increase the popularity of non-formal programs. An example of this strategy would be to bring together non-formal programs such as the local nature center, a nearby resource agency, and a university to offer school districts an academic year of related interpretive field trips that could reflect the primary goal levels of environmental education.

On the next page is an example of a partnership between Indiana University, the U.S. Forest Service and a local school district (Wadszinski & Knapp, 1995). This cooperative project delivered all goal levels of environmental education (as discussed in the Tbilisi Declaration) to seventh and eighth grade students using a local environmental issue (use of the region's wilderness) as the medium for the educational objectives.

This is an example of attempting to link interpretive programs with an environmental education framework. This partnership reflects the depth and long term relationship these specialties must explore to achieve the desired behavior change that both fields espouse.

Another national program that attempts to link interpretation with the formal process of environmental education is Parks as Classrooms - a nationwide program administered by the National Park Service. Its primary goal is to create sustainable partnerships between parks and schools. A key ingredient of Parks as Classrooms is a good working relationship with teachers and integration with school curricula. For example, the Everglades National Park has had a partnership with local school systems for the past 20 years. The program has received national recognition for introducing more than 250,000 student to the issues facing the Everglades. Rocky Mountain National Park has reached out to the local school systems to offer partnership oriented curricula to third through sixth grade teachers and students. These curricula include field trips to the National Park. Similar outreach partnerships have been developed at the Great Smoky Mountain National Park and Cuyahoga Valley National Recreation Area (Reilly & Tevyaw, 1995).

Evaluating the Connection

These examples are exceptions rather than the rule. There continues to be a lack of connection between both fields. One strategy to promote more

The Investigation and Evaluation of Issues Pertaining to The Charles Deam Wilderness Curriculum Framework: Non Formal Integration

Phase I - Basic Knowledge of Wilderness Site: Students learned basic ecological principles regarding the wilderness and its ecosystems.

- Field trip to wilderness led by Hoosier National Forest personnel
- Project Wild activities
- U.S. Forest Service lessons from *Investigating Your Environment*

Phase II - Awareness of Problems and Issues Associated with the Wilderness: Students became aware of and analyzed pertinent environmental issues related to the site.

- Field trip to wilderness led by Hoosier National Forest personnel
- Project Wild and Aquatic activities
- U.S. Forest Service lessons from *Investigating Your Environment*

Phase III - Investigation of Wilderness Issues: Students were enabled to conduct investigations regarding the wilderness issues.

- Classroom visit by Forest Service Interpreter
- *Investigating Your Environment* activities

Phase IV - Knowledge of Action Skills in Regard to Solving Wilderness Problems: Students prepared wilderness policy proposals and gave them to Forest Service officials to attempt remediation of problems.

- Classroom visit by Forest Service Interpreter
- End-of-year assembly program with Forest Supervisor in attendance

partnerships is to learn where an interpretive experience can best integrate into the process of environmental education. The figure on the following page summarizes an important question for both fields - what goal levels of environmental education does an interpretive experience best compliment. Since it has been suggested that an interpretive program is an aspect of environmental education, the query remains as to what aspect it best fulfills.

If an interpreter only has two hours with a visitor what key environmental variables should be addressed? Should these programs be general awareness-based, issue-oriented or a combination of both? Unfortunately, evaluation of the impact of an interpretive experience on environmental behavior is sporadic. Bixler (1991) following a review of research in interpretive programming summarizes an important conclusion, "Research in this area seems to be declining, and there are few researchers systematically analyzing the instructional settings and methods employed by interpreters" (p.33).

One reason for the lack of practical research is the difficulty in evaluating interpretive experiences with regards to long term attitude/behavior change. Many factors come into play which makes it difficult to isolate interpretation's effect on individuals. Despite this challenge a trend in the future must be to study long term impacts of an interpretive program.

Research is currently being conducted by Indiana University to evaluate the impact of interpretive programs that are representative of each of the four major goal levels of environmental education. The quantitative findings have shown that the greatest effect on a visitor is when an interpretive program is representative of the base level goal associated with ecological foundations (Marsan & Knapp, 1996).

Research, however, must continue and expand in order to learn how an interpretive experience can best fit in the scheme of environmental education. More qualitative and quantitative methods must be explored to aid the field in knowing what really can be accomplished in an interpretive experience and how to make the best connection with environmental education.

Promoting the Connection: Partnership Training

An important strategy for the future is to expand training experiences to build better connections between both fields. Environmental educators and interpreters must come together to acquire the knowledge and skills necessary to conduct successful cooperative projects.

Support for this notion was evident in the summer of 1995 when UNESCO, in cooperation with the Mediterranean Information Office in Athens, Greece hosted an inter-region workshop on environmental education. This meeting was held to prepare the central idea for the next UNESCO-UNEP International Congress on Environmental Education and Training in 1997. Its primary mission was to reorient environmental education by incorporating the concept and message of sustainable development. The event was attended by specialists from the five United Nations Regions representing Africa, Latin America & the Caribbean, Asia, the Arab countries, and Europe & North America. Many of the recommendations formulated from this meeting emphasized the importance of partnership training:

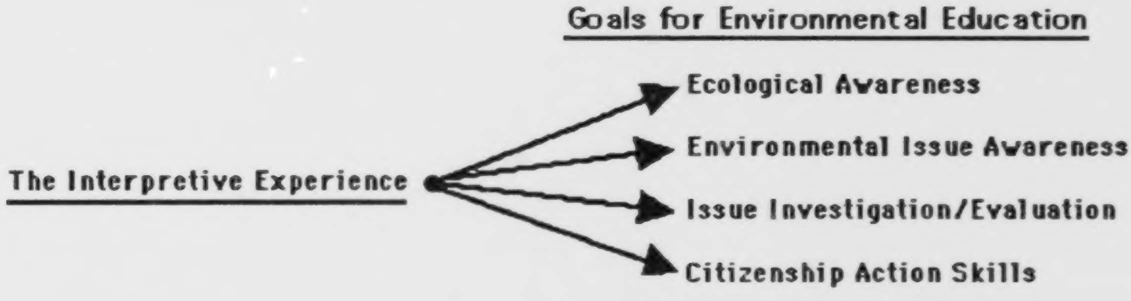
> The group believes that a critical obstacle in the infusion of environmental education is the lack of cooperation and/or communication between educators and other social institutions such as nonformal programs. ...Therefore, these prospective trainers [of environmental education] must be key people representing a variety of social institutions, must be present under one roof and participate in the extensive training of the principles of environmental education. These "baseline" produced partnerships will increase the potential for long term success of environmental education implementation. (UNESCO-UNEP, 1995, p.41)

Developing and conducting training programs is often challenging for a variety of reasons. But it is only by this inservice strategy that accountable partnerships between interpreters and environmental educators can succeed.

Summary

There are important distinctions between environmental interpretation and environmental education. Interpretation tends to be a short term process to reveal information. It caters to a noncaptive audience in a "field setting". Interpretation does not have a program development paradigm; this has resulted in a lack of impact analysis. Environmental education, on the hand, has been establishing itself as an accountable educational process that entails a set of hierarchical goals and an extensive research base.

Although both contend that their ultimate mission is to promote an environmental ethic, only one has the inherent characteristics to achieve this directive. Environmental interpretation must realize its pragmatic abilities and the limitations it possesses. It must also realize its strengths and learn how to use these to enhance its relationship with environmental education. This stronger partnership will help attain the ultimate goal that both fields desire.


Goals for Environmental Education
The Interpretive Experience
Ecological Awareness
Environmental Issue Awareness
Issue Investigation/Evaluation
Citizenship Action Skills

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Evaluation of Natural Resource Education Materials: Implications for Resource Management

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In this interesting and significant study, natural resource education materials for the elementary level were evaluated by the researcher to determine their emphasis on educational content and instructional goals. The majority of materials addressed basic knowledge of ecological principles. Few of these materials helped students develop the critical thinking skills and behaviors which are necessary for them to go from awareness to knowledge to environmental action. Overall, there appeared to be minimal coverage of resource management issues and the higher order instructional goals of analytical skill development and [responsible] environmental behavior. The author also identified the strengths and weaknesses of the lessons and related these to the achievement of environmental education and natural resource management goals.

Educational programs have their greatest influence during childhood, and the foundation of environmental attitudes begins during this impressionable time (Hair and Pomerantz 1987 and references cited therein). For this reason, a number of state natural resource agencies are devoting a significant part of their educational programming to children and young adults. Partnerships are being formed between the state natural resource agency and other state agencies and private organizations devoted to educating young people. To facilitate natural resource education, several states have integrated a natural resource education curriculum into the state's mandated public school curriculum. The Missouri Conservation Department has done this, designing its educational materials so that they not only educate students about conservation issues but also help teachers implement the curriculum requirements for elementary and secondary programs in the public schools. Florida and Oregon, among others, have integrated the curriculum framework from Project WILD with their state's mandated education requirements to demonstrate the applicability of these materials in classroom teaching (Benson and Pomerantz 1990).

New York State has used a similar approach. The Department of Environmental Conservation (DEC) established a set of goals for natural resource education for elementary students (Table 1) and identified 21 principles to be taught to students to achieve these goals (Table 2). An extensive review of DEC's natural resource education goals and principles established their content validity and appropriateness for children in the upper elementary grades (Pomerantz 1988). The goals and principles were then correlated with the New York State Elementary Science Syllabus to facilitate their integration into the school curriculum. To implement these goals, DEC is developing instructional materials that combine videotaped and printed lesson plans to introduce teachers to natural resource education activities. This article focuses on those developmental efforts.

Numerous printed educational materials exist that are designed to communicate basic ecological concepts and resource management principles to elementary school children. Well-known activity guides include Project Wild, Project Learning Tree, NatureScope, and the OBIS materials, among others. Recognizing the value of such guides, DEC decided, whenever possible, to use the activities in those guides in its instructional videos rather than create new lessons. Existing educational materials were therefore evaluated for their ability to (1) convey the essence of the natural resource education principles and (2) be used effectively by teachers and students in the upper elementary grades.

In this article, I analyze elementary-level instructional materials in natural resource education to identify the emphasis on content (i.e., basic ecological principles, wildlife ecology, and resource management) and instructional goals (i.e., knowledge, attitudes, skills, and behavior). Implications of this analysis for teacher utilization of natural resource education materials and achievement of environmental education and natural resource management goals are examined.

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Table 1 - New York State Department of Environmental Conservation's Natural Resource Education Goals for Elementary Students

Superordinate Goal: To have elementary school-aged children develop knowledge, skills, and attitudes to result in commitment to informed decisions and responsible actions toward wildlife and all other living things and their environment.

Subordinate Goal (1): To develop a student population that is knowledgeable about wildlife (e.g., birds and mammals) and the environment.

Subordinate Goal (2): To develop a student population that has a sense of responsibility/ stewardship for wildlife and the environment.

Subordinate Goal (3): To develop a student population that is knowledgeable about wildlife and environmental management principles and practices.

Subordinate Goal (4): To develop a student population that can evaluate and apply information about wildlife and environmental management principles and practices.

Subordinate Goal (5): To develop a student population that can exercise responsible stewardship toward wildlife and the environment.

Methods

An extensive review and analysis of natural resource education materials was performed. Two methods were used to identify sources of educational materials: (1) a survey of teachers from representative teacher organizations in New York State and (2) an extensive literature review, in published and fugitive sources, of natural resource education materials for elementary school children. A purposeful sample of teachers from organizations representing science, social studies, math, and environmental education were surveyed in January 1988. Teachers who were identified by their organization as having a special interest in environmental education were asked to identify lessons they had used successfully to communicate concepts in wildlife ecology, resource management, or general environmental issues. Materials identified by teachers were acquired and subsequently evaluated

The literature review identified published and fugitive sources of natural resource education materials through the Educational Resources Information Center (ERIC) bibliographic system, directories of sciences and environmental education curriculum materials, curriculum fairs, and personal referrals. A bibliography and library of natural resource education materials appropriate for upper-level elementary school students was compiled that inluded publications from state natural resource agencies (e.g., Alaska, New Jersey, Missouri); federal natural resource agencies (e.g., *U.S. Fisheries and Wildlife Service* and *U.S. Forest Service)*; conservation organizations (e.g., National Wildlife Federation's NatureScope, New York Zoological Society's WIZE and ZIPS, Western Regional Environmental Education Council's Project WILD, Aquatic Project WILD, and WREEC and American Forest Foundation's Project Learning Tree); educational institutions (e.g., ERIC materials, OBIS); and independent authors. From this effort, 109 sources were initially reviewed to determine whether their general content and instructional level were appropriate for DEC's natural resource education principles at the elementary level. Of these, 72 instructional guides were selected for analysis because they were designed for grades 3 through middle school and dealt with natural resource issues and general ecological principles. The individual lesson plans within each activity guide were then screened to determine the specific curriculum objectives they addressed and how well the lesson met certain instructional criteria.

The Screening Process

The source materials identified through these two methods were then evaluated through a two-stage screening process. At the first stage, materials were screened to determine if they (1) were appropriate for use with upper level elementary school children, (2) focused on basic ecological principles or resource management concepts, and (3) were applicable to students in the Northeast (United States). Educational materials that met these criteria were passed to the second stage of screening; at this stage, the individual lessons that best represented the natural resource education principles and had the greatest chance for classroom success were identified. A screening instrument (based on the format of Gardella's Environmental Education Curriculum Inventory [1986]) was developed to evaluate individual lessons for their ability to meet established educational criteria.

Evaluators worked in pairs to screen the individual lessons. The screening was done in two stages: (1) each member of the evaluation pair independently reviewed the lessons with the screening instrument; and then (2) both evaluators reconciled their independent reviews through consultation. This two-stage screening with pairs of evaluators was used to minimize the effect of variability among independent reviewers. (A pretesting of the screening process indicated a high degree of variability among independent evaluators. The second stage of the process was therefore implemented to force independent evaluators to justify their review and reconcile differences in interpretation.) The members of the evaluation pair were periodically changed to further minimize individual bias.

For purposes of this evaluation, materials screened were labeled according to the following categories: "wildlife education" if the material dealt with basic information about wildlife, wildlife needs, or wildlife habitat; "resource management" if the lesson discussed aspects of wildlife or environmental management; and "general environmental education" if the lessons dealt with basic ecological principles and environmental issues, not specific management concerns.

Results

Lesson Content

The screening of 994 individual lessons demonstrated the relative emphasis on various content areas and instructional goals in these natural resource education materials. If a lesson did not cover any of the natural resource education principles, it was not screened further; 294 lessons were consequently eliminated. Analysis of the 700 remaining lessons revealed that the most extensive coverage was given to basic ecological principles (Table 2). The lessons emphasized that all living things operate according to natural laws and indicated that people are an interactive part of the environment and can analyze the impact of their actions. These topics were covered extensively by 29% to 39.3% of the units, and more moderately by 30.3% to 40% of the other units screened. The cultural, economic, and ecological importance of wildlife and the necessity of responsible stewardship was covered extensively in 4.7% to 9.1% of the lessons and was given some coverage by 21% to 26.6% of the others. Identification of types of resource management activities was given some coverage in about 23% of the lessons, and extensive coverage by 6% or less. Specific treatment of management issues and land-use decisions was given some coverage in 6.7% to 14.6% of the units, and extensive coverage in 6.3% or less. Fully half of the 700 units focused mainly on general environmental education, with wildlife education and resource management the major focus in less than a quarter (23.1% and 23.4%, respectively) of the lessons screened.

Instructional Goals

Analysis of instructional goals in the lessons showed that 98.1% of the lessons addressed knowledge about wildlife and the environment. Thirty-one percent dealt with knowledge about wildlife and environmental management principles and practices. Less than half of the units (41.9%) dealt with attitudes of responsibility or stewardship for wildlife and the environment. The instructional goals dealt with least often were skills to evaluate and apply information about wildlife and environmental management principles and practices (13.9% of the units) and behavior that exercises responsible stewardship (10.7% of the units). The instructional goal most emphasized by the majority of lessons (64.7%) was knowledge about wildlife and the environment.

Almost two-thirds of the lessons that addressed knowledge about wildlife and the environment focused primarily on general environmental education. Nearly one-third concentrated on wildlife education (Table 3). As expected, lessons about resource management made up the majority (80.2%) of the lessons that dealt with knowledge about wildlife and environmental management principles and practices. Of the lessons that stressed attitudes of responsible stewardship for wildlife and the environment, those with a focus on resource management predominated (43.5%), followed by lessons in general environmental education (33.9%).

Integration with School Subjects

Because of limited classroom time, most resource education activities are designed to be integrated into existing subject areas within the school curriculum. It was found that almost all the lessons (97.1%) addressed objectives in science, fol

Table 2 - Percentage of Lessons that Addressed Principles in Natural Resource Education

	Percentage of lessons (N = 700)		
Principles for natural resource education	No coverage	Some coverage	Extensive coverage
1. All living things, including people, have basic needs (i.e., Food-Air-Water-Space).	42.4	38.9	18.7
2. All living things, including people, operate according to natural laws (e.g., laws of gravitation) that are fixed and ultimately binding.	30.4	30.3	39.3
3. Plants and animals depend on each other in many ways.	46.6	35.7	17.7
4. People not only share their environment with other living things but are an interactive part of that environment.	28.9	40.0	31.1
5. Humans can adjust to and alter their environment far more than any other living thing. Therefore, humans have the greatest responsibility for that environment.	54.7	26.7	18.6
6. People can analyze factors affecting the environment, predict future trends, and make deliberate decisions based on this information (e.g., identifying sources of air pollution and taking steps to correct these problems).	33.0	38.0	29.0
7. Because of the interdependence of plants and animals, the conditions of wildlife habitat reflect the quality of the environment for all living things including people (e.g., the presence of chemical contaminants in the Hudson River).	71.4	23.7	4.9
8. Wildlife is important in the cultural heritage and economic welfare of many regions and groups of people (e.g., NYS example).	67.7	23.4	8.9
9. Trying to understand and enhance the conditions of wildlife and wildlife habitat necessitates some form of responsible stewardship.	63.3	26.6	9.1
10. Stewardship involves decisions to intervene or not. Intervention may take several forms, one of which is management of living things; another is management of nonliving things; still another is education.	74.3	21.0	4.7
11. Management as a form of stewardship can be carried out by individuals, community groups, or government agencies.	85.9	12.7	1.4
12. Scarcity of any factor essential for survival limits population growth, in which case an abundance of all other factors makes little difference.	56.6	31.0	12.4
13. Wildlife and environmental management is the process of modifying those factors that can be controlled by people.	82.1	15.7	2.1

Table 2, Continued - Percentage of Lessons that Addressed Principles in Natural Resource Education

	Percentage of lessons (*N* = 700)		
Principles for natural resource education	No coverage	Some coverage	Extensive coverage
14. These factors include nonliving examples (e.g., soil-air-water-space) and living elements, both human and nonhuman.	75.1	22.1	2.7
15. Wildlife and environmental management include monitoring (e.g., counting ducks on NY lakes in winter; measuring acidity of mountain lakes), manipulation (e.g., cutting timber, mowing, burning; water diversions such as dams), and regulation (e.g., laws regulating taking game animals; air and water standards).	69.9	23.7	6.4
16. Wildlife and environmental management may have positive effects on some wildlife or aspects of the environment and negative effects on other aspects (e.g., succession to mature hardwoods that would benefit the gray squirrel and turkey).	86.6	9.2	4.3
17. Management activities can encourage some types of human behavior and restrict others (e.g., protecting wetlands provide opportunities for recreation but limits agriculture and commercial development).	85.7	12.4	1.9
18. To be responsible stewards, people must be knowledgeable about wildlife and environmental management options and be prepared to consider the consequences of management activities.	84.7	13.8	1.9
19. Responsible stewardship also includes personal and community action that benefits wildlife and the environment.	79.7	14.6	5.7
20. Because wildlife and the environment mean different things to different people, decisions about their management are often complex and controversial.	85.1	8.6	6.3
21. Careful decision making is accomplished by identifying the problem, obtaining and evaluating information, considering alternative solutions and their consequences, and making a choice.	87.9	6.7	5.4

lowed by objectives in social studies (37.6%), language arts (18.6%), art (15.7%), and math (9.4%). Few activities met objectives in physical education (3.0%) or drama (2.3%). Almost all lessons in the three major focus areas of wildlife education, resource management, and general environmental education met objectives in science (Table 4). In addition, about one-fourth of the lessons emphasizing wildlife education met objectives in social studies and art. Over two-thirds of the lessons that focused on resource management met objectives in social studies, and almost one-third addressed language arts objectives. About one-fourth of the activities with a primary focus in general environmental education addressed social studies objectives.

Within each school subject area, the majority of lessons emphasized knowledge about wildlife and the environment (Table 5). Over one-third of the lessons that addressed objectives in social studies dealt with environmental attitudes. About one-quarter of the lessons with objectives in language arts dealt with knowledge about wildlife and environmental management and attitudes of environmental responsibility.

Table 3 - Percentage of Lessons that Addressed Each Instructional Goal

Instructional goals	Percentage of lessons in Wildlife education	 Resource management	 General environmental education	Row %	Total No.
Knowledge about wildlife and the environment	30.8	3.3	63.3	100	452
Knowledge about wildlife and environmental management principles and practices	4.9	80.2	14.8	100	81
Attitudes of responsibility/ stewardship for wildlife and the environment	12.9	43.5	33.9	100	124
Skills to evaluate and apply information about wildlife and environmental management principles and practices	4.8	61.9	33.3	100	21
Behavior that exercises responsible stewardship toward wildlife and the environment	9.5	81.0	9.5	100	21

Table 4 - Percentage of Lessons that Addressed Curriculum Objectives in School Subjects

Subject area	Percentage of lessons in Wildlife education (N 162)	 Resource management (N = 164)	 General environmental education (N = 350)
Science	100.0	96.3	98.0
Social studies	24.1	67.1	27.1
Language arts	16.5	29.9	13.7
Art	25.3	7.3	15.4
Math	10.5	12.2	8.0
Drama	3.7	.6	2.3
Physical education	8.6	.6	1.7

Table 5 - Percentage of Lessons that Addressed Instructional Goals in Each Curriculum Subject Area

	Percentage of lessons with instructional goals						
	Wildlife	Management				Row total	
Subject Area	knowledge	knowledge	Attitudes	Skills	Behavior	%	No.
Science	65.1	11.3	17.5	2.9	3.1	100	680
Social studies	36.6	19.1	35.5	4.2	4.6	100	262
Language arts	43.1	25.4	23.1	6.2	2.3	100	130
Art	76.4	4.5	13.6	1.8	3.6	100	110
Math	53.0	13.6	19.7	9.1	4.5	100	66

Implementation

A number of criteria were used to evaluate how well the lessons could be used by teachers. The lessons were strongest in providing extensive directions for activities (71.4%), accurate information (100%), applications of the principles to real-life situations (92.9%), and relevancy to local or regional concerns in the Northeast (91.0%). Most lessons also used experiential teaching strategies (72.1%) and required students to hone inquiry problem-solving skills (75.7%). The lessons were weakest in providing: (1) useful background information for the teacher (33% offered extensive information, 39.6% offered some information, 27.4% offered none) and (2) criteria to evaluate student achievement of the unit's objectives (39.7% offered extensive criteria, 52.7% offered some, 7.6% offered none). Sixty-one percent of the lessons integrated objectives from more than one subject area, 43% used timely examples to illustrate principles, and 40% required an outdoor environment to conduct the activity.

Discussion

The greatest emphasis in natural resource education materials for elementary students is on basic knowledge of ecological principles. This is an appropriate emphasis at the lower grade levels, where children need to be introduced to the ecological foundations that underlie resource management (Hungerford et al. 1980). However, if educators and resource managers expect children to be able to understand resource management issues and to begin to apply their knowledge of ecological principles to resource management problems, they must begin to expose students to these issues. The lessons available for elementary students give little coverage to the range of wildlife values. Few lessons devoted to principles of resource management exist as well. Fifth- and sixth-grade students are capable of analyzing land-use issues. At a minimum, they should be made aware of the types of wildlife and environmental management concerns facing society today. The resource materials designed for this age group, however, give little attention to this area.

Furthermore, the natural resource education lessons present few opportunities for students to develop the critical thinking skills and behaviors that will enable them to go from awareness and knowledge to environmental action. As Volk et al. (1984) indicated, the ultimate goal of environmental education is [responsible citizenship] action. Yet very few environmental education curricula incorporate these goals into their programs. This analysis of natural resource education materials available to teachers confirms this observation; the majority of lessons were found to concentrate only on basic knowledge. The materials screened give only moderate attention to attitudes toward wildlife and the environment, and minimal attention to skills for applying and evaluating information and to environmentally responsible behavior. The instructional goals of attitudes, skills, and behavior are treated primarily in lessons about resource management. The issues inherent in resource management lend themselves to addressing these higher-level objectives, and it is encouraging that these goals are being incorporated to some degree. It is important that greater emphasis be placed on these higher goal levels if the ultimate objectives of natural resource education are to be met (Howe et al. 1987; Hungerford and Volk 1984).

Sewing (1986) labeled the lack of consensus about the scope and content of environmental education as "conceptual barriers" to environmental education. These conceptual barriers could be broken down more easily if there were not only school curricula that emphasized a comprehensive set of environmental education goals (Volk et al. 1984) but resource materials that reflected them. Readily available resource materials would enable teachers to directly implement goals at the appropriate level. This would reduce some of the "logistical barriers" (e.g., time and insufficient instructional materials) to educating students about the environment.

To affect the logistical barrier of insufficient time to address natural resource and environmental education in the classroom, teachers need to find an appropriate place to integrate this material into their existing subject areas (Simmons 1989). Almost all the natural resource education lessons address science objectives, and this is clearly a logical entry point into the school curriculum. However, science constitutes a relatively small part of the elementary program compared with the subjects of reading and math. A low proportion of the natural resource education materials met specific objectives in language arts and math. These are two important curriculum areas that should be addressed more directly in the development of new materials or the modification of existing ones to facilitate integration. Another logical infusion point is in social studies. A substantial proportion of current lessons address objectives in this area, with the majority focusing on resource management. This is encouraging, especially since many of these lessons also address the higher instructional goals of skill development and environmentally responsible behavior.

Because the preservice preparation and inservice training of teachers in environmental education have been inadequate (Childress 1978; Hooper 1981; Trent 1983; Hungerford and Volk 1984; Howe et al. 1987), teachers often lack the preparation and confidence to teach environmental education (Rellergert-Taylor et al. 1987). To overcome some of these "educational barriers" (Sewing 1986), instructional materials must provide adequate background information and clear directions. The implementation of natural resource education will be facilitated if lesson content and procedures are easy for teachers to understand, have direct relevancy to students' lives, and employ age-appropriate learning strategies. The natural resource education materials met many of these criteria. The majority provided good directions, applications to real-life situations, and accurate information. Furthermore, most lessons used "hands-on" activities, which is an appropriate teaching method for elementary children in the concrete stages of cognitive development (Ripple et al. 1982). The lessons were weak, however, in providing adequate background information and criteria to evaluate student performance. It is critical that teachers' confidence in using natural resource education activities be bolstered as much as possible. More extensive background information on a topic can provide additional subject-matter expertise that could help overcome teachers' initial reluctance to present environmental material to students. In addition, better coverage of student-performance evaluation would clarify achievement of instructional objectives and justify the value of such activities.

Conclusions

Assessment of school curricula in environmental education has indicated that environmental education programs primarily address base-level goals of environmental awareness and knowledge. Similarly, the evaluation of natural resource education materials for elementary students revealed that most instructional materials are designed to address basic knowledge of ecological principles. Little attention is given to specific resource management issues, and few lessons encourage students to develop analytical skills and environmentally conscious behavior. A challenge to the field of natural resource education is, first, to make children aware of key resource management issues and, second, to bring them beyond awareness to an informed, participatory level.

> **. . . few lessons encourage students to develop analytical skills and environmentally conscious behavior.**

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Are We Meeting the Goal of Responsible Environmental Behavior? An Examination of Nature and Environmental Education Center Goals

Deborah A. Simmons

In this important research study, Dr. Simmons strove to determine the extent to which nature and environmental education centers were meeting generally accepted goals of environmental education and especially the goal of developing responsible environmental behavior. In her discussion she states, ". . . there is considerable resistance [on the part of the center's] to supporting the goals of influencing people's attitudes, disseminating information about local environmental issues, or even helping people develop environmental problem-solving skills. . . . how can a center enable people to act in an environmentally responsible way unless they are provided with the necessary set of tools?" The data associated with this study are approximately a decade old. To what extent has the situation changed?

The goals of nature and environmental education centers reflect certain purposes and philosophies that guide the development of programs, services, and the physical features of the facility itself. By looking at the goals of these centers nationwide, we can obtain a snapshot of the field as it is being defined and put into action. My purpose in this article is to describe the varied goals of centers throughout the United States and to examine the degree to which they are consistent with the generally accepted goals of the field of environmental education. I especially focus on the process of meeting the commonly expressed goal of encouraging environmentally responsible behavior.

Throughout the development of environmental education, goals have been widely described and debated in the literature (Harvey 1977; Childress 1978; Disinger 1983; Volk 1984). Early on, Stapp et al. (1969) proposed that environmental education should work to develop a citizenry that "is knowledgeable concerning the bio-physical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution." Similarly, a set of guiding principles were developed as a result of the Tbilisi conference (Jeske 1978, p. 17): "to foster clear awareness of, and concern about economic, social, political and ecological interdependence in urban and rural areas; to provide every person with opportunities to acquire the knowledge, values, attitudes, commitments and skills needed to protect and improve the environment; to create new patterns of behavior of individuals, groups and society as a whole towards the environment." Finally, Hungerford, Peyton, and Wilke (1980, p. 43) presented a "superordinate goal" for environmental education: "to aid citizens in becoming environmentally knowledgeable and, above all, skilled and dedicated citizens who are willing to work, individually and collectively, toward achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment."

Goals and a Proposed Behavior Model

The goals described above all suggest that encouraging environmentally sound behavior is a desired outcome of environmental education. Marcinkowski (1990) goes one step further and argues that not only has responsible environmental behavior been considered a goal of EE, but that "involvement in such activities has often been identified as the terminal goal of EE." In essence, the various goal statements establish a process through which knowledge, attitudes, skills, commitment, and motivation play integral roles in insuring that the terminal goal of environmentally sound behaviors can be met. To this end, environmental education as defined in a recent UNESCO document (1987, p. 2) describes a model of action "in which individuals and the community gain awareness of their environment and acquire the knowledge, val-

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ues, skills, experiences and also the determination which will enable them to act - individually and collectively - to solve present and future environmental problems."

By the use of the phrase "enable them to act," the UNESCO definition suggests a model in which there is a direct relationship between awareness, knowledge, values, skills, and determination and the ability of individuals to act on environmental problems. This defined relationship, outlining the role of specific precursors of environmentally responsible behavior, is also supported by a broad range of environment-behavior research. For example, Borden and Schettino (1979) found that environmental behaviors were linked to both a concern for the environment and a general knowledge of environmental issues. In a study of recyclers and nonrecyclers, Arbuthnot (1977) found that knowledge of recycling, a sense of personal responsibility, and locus of control were predictors of recycling behavior. Heberlein and Black (1976) found that those who use lead-free gasoline were more knowledgeable about the issue, expressed a greater concern, were more likely to feel that their personal action could make a difference, and felt a greater sense of responsibility than those who did not use lead-free gasoline. Finally, Simmons and Widmar (1989a) proposed that recycling behavior depends upon an individual's sense of responsibility, conservation ethic, knowledge of what to recycle, understanding of how to recycle, and sense of personal efficacy.

In the very least, the individual studies briefly mentioned seem to suggest a number of variables that may be linked to responsible environmental behavior. Going one step further, Hines (1984) synthesized a wide range of environment-behavior research and proposed a model of environmental behavior. Through a meta-analysis of research, Hines suggests that environmental behavior is associated with such components as personality factors (attitudes, locus of control, efficacy perception, personal responsibility); knowledge of issues; knowledge of action strategies and action skills; intention to act; and situational factors (constraints and opportunities). Building upon the Hines behavior model and drawing upon additional research, Hungerford and Volk (1990) have proposed an expanded behavior model. Hungerford and Volk believe that a set of major variables (environmental sensitivity, in-depth knowledge about issues, personal investment in issues, knowledge of and skill in using action strategies, locus of control, and intention to act) and minor variables (knowledge of ecology, androgyny, attitudes, knowledge of the consequences of behavior, and a personal commitment to issue resolution) contribute to responsible environmental behavior.

Drawing from this literature and especially the two models described above, one can suggest a simplified behavior model that would also be compatible with the goals of environmental education. Consequently, for the purposes of this article, this simplified behavior model proposes that knowledge (knowledge of issues as well as knowledge of natural systems), problem-solving skills, and psychological factors (especially attitudes and the development of self-esteem) all contribute to the development of environmentally responsible behavior. The relationship among the contributing variables and environmentally responsible behavior is assumed to be synergistic. Furthermore, the model would suggest that for a program to be successful in encouraging environmentally sound behaviors, it must, to one degree or another, address each of the contributing variables. That is, if a program hopes to encourage environmentally responsible behavior, then knowledge of issues, knowledge of natural systems, problem-solving skills, attitudes, and the development of self-esteem should be included as program-level goals.

In this article, I examine the congruence between the expressed goals of nature and environmental education centers in the United States and the behavior model described above. The analysis provides a description of how the field is being defined by centers, that is, which goals are endorsed and which are not endorsed. More important, however, by comparing the centers' goals with the behavior model, the analysis will give an indication of our effectiveness in meeting the terminal goal of encouraging environmentally sound behavior.

Data Collection

The discussion of goals presented in this article is based on two different sets of data. The first was collected at the 1989 Natural Science for Youth Foundation national conference. Over 100 conference attendees answered 13 open-ended questions that focused on the challenges facing centers, the definition of mission and goals for centers, and the difficulties of developing financial support (see Simmons and Widmar 1989b). The questions formed the basis for small-group roundtable discussions. These discussions were tape recorded and transcribed. I have used quotations from the roundtable discussions and the written responses to the questionnaire to illustrate and illuminate the results of the second study described below. These quotations provide anecdotal information on what the goals of centers are and the relationships among them.

The second data set involves information gathered from 1,225 nature and environmental education centers throughout the United States. The center respondents filled out a detailed questionnaire as part of the development of the Directory of Nature and Environmental Education Centers, published by the Natural Science for Youth Foundation (NSYF 1990). The questionnaire contained items concerning the center's mission and goals, program, audience, management, and facilities. The individuals filling out the directory questionnaire were provided with a list of goal statements and were asked to rate each item as to whether it was a major goal, a minor goal, or not a goal of their center. The survey respondents' answers reflect a broad definition of nature and environmental education centers that includes zoos, aquariums, museums, resident centers, parks, nature centers, and wildlife preserves (Table 1).

Results

Program Goals

Nature study was the most frequently (76.1%) mentioned goal (see Table 2). Significantly more centers indicated nature study than any other goal. The second most frequently mentioned goal was encouraging environmentally sound behavior (74.4%), followed by teaching local natural history (71.5%) and influencing people's attitudes (66%). The remaining five goal statements were each mentioned by fewer than half of the centers as either major or minor goals. It is interesting to note that so few of the centers consider these to be primary goals. Fewer than 15% endorsed disseminating local environmental issues information or helping people develop self-esteem as major goals; only 6.7% indicated that environmental activism is a major goal.

Congruence between Expressed Goals and the Behavior Model

The goal statements show both the diversity of philosophies held by centers as well as the underlying similarities. These statements taken alone are of interest, but the information that is particularly enlightening is the degree to which the statements reflect the centers' implicit models of how to encourage environmentally sound behaviors and the roles that the centers see themselves playing in enabling these behaviors. In the following analysis, I examine the goal statements in combination with one another to determine the degree to which the various components of the behavior model have been endorsed (Table 3).

TABLE 1. - Characteristics of the Centers Surveyed, in Percentages

Setting
- Urban (57%)
- Suburban (24.9%)
- Rural (18%)

Audiences served
- Urban (80.9%)
- Suburban (83.7%)
- Rural (71.5%)

- Elementary school groups (95.3%)
- Secondary school groups (85.4%)
- General public (88.8%)
- Youth groups (81%)
- In-service teachers (57.3%)

Ownership/operator of center
- Municipal (12.4%)
- County (13.8%)
- State (15.6%)
- Federal (13.3%)
- Special government district (1.2%)
- Private nonprofit (38.8%)
- Private (industry) (1.5%)
- Private for profit (1.6%)
- College/university (6.7%)
- School system (2.3%)

Programs offered by > 50% of centers
- Environmental education (79.7%)
- Wildlife (75.9%)
- Botany (58.8%)
- Ecological science (53.6%)
- Geology (52.8%)
- Aquatic studies (51.6%)
- Science education (50.4%)

The Role of Nature Study

At the root of the programs surveyed is the importance of studying nature. For some centers, nature study is a goal in and of itself, with the end being greater knowledge of the natural world. For nearly 10% of the centers, the only goal indicated was nature study or teaching about local natural history. Nature study may be seen as a way of instilling appreciation or encouraging preservation.

TABLE 2. - Center Goals Indicated by Respondents

Goal	Major goal (%)	Minor goal (%)	Combined total % (major and minor)
Nature study	57.0	19.1	76.1
Encouraging environmentally sound behaviors	50.3	24.1	74.4
Teaching local natural history	46.9	24.6	71.5
Influencing people's attitudes	41.9	24.1	66.0
Disseminating local environmental issues information	13.6	29.9	43.5
Developing environmental problem-solving skills	17.5	23.1	40.6
Helping people develop self-esteem	14.9	16.7	31.6
Environmental activism	6.7	22.1	28.8

As one participant in the roundtable stated, "Our mission is to preserve and enhance environmental quality through natural science education." Members of the roundtable discussions also suggested that through nature study people could be connected with the environment: "The goal is to reestablish the bond between man and the natural world and thereby establish a concern for conservation"; "You can't build a relationship with nature unless you have contact with the natural world"; that nature study provides a "doorway of knowledge, first-hand experience of the world around us"; and that this direct experience is essential because "you will accomplish more by allowing a little hand to run across the back of a rabbit than with all the words in the world." Thus, nature study can be seen as the foundation upon which a connection with, or appreciation of, the environment is formed.

But although nature study forms a common thread for most centers, other goals may be combined with it to test the degree to which the various components of the behavior model have been endorsed. Sixty-four percent of the respondents indicated that both nature study and encouraging environmentally sound behaviors expressed a similar purpose, suggesting that through nature study, environmentally responsible lifestyles could be developed. The participants indicated that they often saw nature study as a way to show the interconnectedness of life and make clear the need for responsible behaviors: "We must teach that human well-being is dependent upon a realization that we are interdependent with all living things and have a responsibility toward long term protection of living systems." One participant proposed that the goal was "to help people understand how life on this planet functions, that man is directly tied to those systems and communities, and that man has to change his lifestyle in order to live in harmony with the earth."

The Role of Attitude Change

Connecting nature study with motivating people to responsible environmental behavior reflects a simple model of how behavior change comes about. This model assumes that there is a direct connection between knowledge acquisition (nature study) and appropriate behavior. Respondents from some centers saw attitudes and attitude change as essential to the role played by nature and environmental education centers. Thus, a combination of influencing people's attitudes and nature study can form an expanded model of how a center might encourage responsible environmental behavior. Approximately half of those surveyed (52%) indicated that nature study, influencing people's attitudes, and encouraging environmentally sound behaviors were all goals of their programs (Table 3). One of the roundtable participants suggested that nature study provided an "opportunity for all ages to learn about their relationship to the fragile environment and how their attitudes may help or hinder our future."

The issue of explicitly trying to change attitudes, however, is not embraced wholeheartedly by all centers. Significantly fewer centers listed influencing people's attitudes as a goal, compared with the goals of nature study, encouraging environmentally sound behavior, or teaching local natural history (Table 2). Some find the idea of actively promoting a set of attitudes distasteful. As one roundtable participant asked, "Are you seeing this as presenting both sides of the issue or are you in an advocacy role, because there is a real big difference?" Others seemed to be concerned with the ability of centers to influence attitudes: "The basic issue is people's attitude toward the environment. But it's so nebulous you can't go up to someone and say 'let me teach you about your attitude toward the environment'; it's so mushy you can't get a hold of it so we do all this other stuff - how do you reach a person and move them?"

The Role of Local Environmental Issue Information

If including attitude change as part of the center's goals is not highly endorsed, the other proposed components of the behavior model are even less often included as goals (e.g., enhancing problem-solving skills, increasing self-esteem). Disseminating information on local environmental issues was considered a goal by 43.5%, with only 13.6% considering it a primary goal (Table 2). Although the behavior model speaks of the need for people to gain knowledge of environmental issues in order to act, only 36.9% of the centers combine disseminating local environmental issues information with nature study as a means of encouraging environmentally sound behavior (Table 3). Some individuals at the roundtable spoke of the center's role as provider of issue information, serving, as one participant put it, as an "information warehouse."

Once again, however, some centers expressed concern over the need to be seen as an unbiased source of information: "You need to stay current with issues and maintain a certain objectivity so people in the community trust you as a source of information." Similarly, avoiding local environmental issues may be due to a concern over becoming involved with controversial issues: "We tiptoe around issues that have any political overtones. So for us to do programs on even local community environmental issues is something we have to be careful about. And yet, we are the ones that should be doing that. How are nature centers going to do that as money gets tighter and tighter, and we are more and more afraid of losing it by stepping on people's toes or losing governmental support? Is this our role or not?"

It is interesting to note that whereas there was a strong endorsement of nature study (76.1%) as a method of providing a knowledge base, significantly fewer respondents considered disseminating information about local environmental issues (43.5%) as an appropriate method of increasing knowledge. There seems to be a resistance to delving into areas that may have political overtones. The centers appear to be trying to avoid controversy, choosing to define their educational roles narrowly and safely.

The Role of Environmental Problem-Solving Skills

Research has indicated that skills development is an important element in encouraging environmentally responsible behaviors. Hines (1984)

TABLE 3. - Endorsement of Behavior Model Components

Model components	Centers endorsing (%)
Nature study + environmental behavior	64.4
Nature study + influencing attitudes + environmental behavior	48.9
Nature study + local issue information + environmental behavior	36.9
Nature study + problem-solving skills + environmental behavior	36.1
Nature study + developing self-esteem + environmental behavior	27.4

There seems to be a resistance to delving into areas that may have political overtones. The centers appear to be trying to avoid controversy, choosing to define their educational roles narrowly and safely.

stated that "an individual's ability to act is dependent not only upon possessing knowledge of how to act, but also upon an individual's skill in applying that knowledge to the problem. The erroneous assumption is often made that skills evolve naturally from knowledge." Given the importance placed on skill development, it is disappointing that only 40.6% of the centers (Table 2) include developing environmental problem-solving skills as a goal. Even more disappointing, however, only 36.1% see environmental problem-solving skills as being a part of the behavior model that contributes to environmentally sound behaviors (Table 3).

Similarly, few of the roundtable participants spoke, even generally, of the need to help people gain skills to solve environmental problems. One participant suggested that "it is wonderful to raise awareness, but we don't often take that step of tying it into something specific and promoting the skills to keep the environment in a healthy state."

The Role of Developing Self-Esteem

Likewise, few centers focus on helping people develop self-esteem (31.6%). None of the roundtable discussions centered on the role of helping people to feel confident in their abilities to make a difference. Only 27.4% (Table 3) of the centers indicated that increasing self-esteem, nature study, and encouraging environmentally sound behaviors are goals. Although self-esteem may represent only one of a number of psychological factors related to environmental behavior (i.e., locus of control, commitment, efficacy, and so forth), its low level of endorsement suggests that centers are not emphasizing these precursors to environmental behavior in their programs.

The Role of Environmental Activism

Finally, the uneasiness of dealing with attitudes is only intensified when one asks if environmental activism is a goal. Less than one third of the centers considered this as a goal, and only 6.7% considered it a primary goal (Table 2). The question of environmental activism inspired heated discussions at the roundtable, with some arguing strongly that programs needed to promote "action, not just education," and to give people the skills and motivation to "speak up and attend meetings." There was some hope that "some day the kids I educate will speak up when it comes to making decisions about the environment." There was also a recognition of the need to design programs to ensure responsible action: "If we don't consciously try to help people make that transfer, it just isn't going to happen. So many curriculum guides are great until they get to the action segment and then it's totally ineffective. It's not looking at it personally. What can the individual do beyond picking up some litter in the street?" There were those who sharply disagreed with taking any advocacy role: "Our mission is education and not lobbying," and "ours is an education role rather than an advocacy role. We try to present both sides of an issue. We don't take a stand about what we think you should do."

It is noteworthy that significantly more centers endorse encouraging environmental behavior (74.4%) than endorse promoting environmental activism (28.8%). It seems that environmental activism, with its implied political action, is considered beyond the scope of most centers, whereas encouraging environmental lifestyles is considered appropriate.

Discussion

At the very least, the results illustrate the diversity of programs within the nature and environmental education centers surveyed. Some have defined their purpose in terms of nature study and teaching about local natural history, whereas others see their role as that of a change agent, programming for environmental activism.

Perhaps of greater interest is the apparent inconsistency among the endorsement of various goals. The centers seem to be comfortable with the idea of actively encouraging environmental behav

. . . the uneasiness of dealing with attitudes is only intensified when one asks if environmental activism is a goal. . . . The question of environmental activism inspired heated discussions at the roundtable . . .

ior. Nearly three-quarters of the centers endorsed helping people change their lifestyles. On the other hand, there is considerable resistance to supporting the goals of influencing people's attitudes, disseminating information about local environmental issues, or even helping people develop environmental problem-solving skills. For the most part, centers are endorsing a behavior model that simplistically links nature study directly to environmental behavior.

The question is, however, how can a center enable people to act in an environmentally responsible way unless they are provided with the necessary set of tools? Only 15% of the centers endorsed the full set of goals (i.e., nature study, attitudes, problem-solving skills, local environmental issues information, self-esteem, and environmentally sound behaviors). The results suggest that centers need to examine closely their stated goals and the programs inspired by them. If the centers are among the vast majority endorsing responsible environmental behavior, do their other goals facilitate those behaviors or are they assuming that attitudes and skills will develop on their own? If centers truly hope to help people lead more environmentally responsible lifestyles, they must also be prepared to help people acquire the necessary knowledge (both nature study and issue-specific information), attitudes, commitment, and skills.

The results of this study point to the need for continuous, long-term program evaluation. Even though nearly 80% of the centers stated that they are teaching environmental education (see Table 1), most are not explicitly incorporating the goals of environmental education (UNESCO 1987) within the center's goal structure. Moreover, given the research in environmental behavior, one would suspect that those centers providing nature study with the goal of encouraging environmentally sound behaviors are not achieving this goal. Without program evaluations, however, whether a center's goals are being met or not is unknown. Developing an evaluation would allow the center to clarify its goals, identify whether the program provided is consistent with the goals, and determine if these goals are being met.

In conclusion, a word must be said about the limitations of this study. Because of the length of the survey, the number of goal statements provided was kept to a minimum. Consequently, centers were not asked about such potential goals as values clarification or building a sense of efficacy. Additionally, goal statements were not defined for the centers; a goal such as environmental activism may mean very different things to respondents. Whereas some may see environmental activism as implying participation in political activities, others may define it in terms of an organized clean-up campaign. Further research should be designed to clarify these issues.

> **. . . how can a center enable people to act in an environmentally responsible way unless they are provided with the necessary set of tools?**

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Epilogue *or* Some Further Thoughts on: "Are We Meeting the Goal of Responsible Environmental Behavior?"

I believe that as a field environmental education has made significant progress over the last several years. Our understanding of EE practice continues to grow through an increase in the quality of research efforts and the development of well conceived and evaluated programs in place throughout the country. We have even made some initial strides towards truly connecting environmental education with the formal education system.

But some of the basic issues raised in this article still seem to hound the field. What goes under the general umbrella of environmental education seems to mean different things, at least in practice, to different people, and all too often the basic substance of environmental education is doled out to learners in a series of unconnected activities or experiences. Students explore concepts related to the water cycle in science, analyze population data in social studies, and conduct an examination of the hazards of lead poisoning in health class. The curriculum has yet to be integrated so that knowledge and skills can build upon one another.

Although a follow-up study of nature and environmental education centers has not been completed, some indication of the continued need to work toward greater coherence has been found in an examination of curriculum materials currently being conducted. As part of the National Project for Excellence in Environmental Education a vast array of curriculum materials are being reviewed by panels of teachers, environmental educators and content specialists. These reviews provide an indication of the breadth and depth of the field. The reviews consider six key characteristics of quality environmental education materials: factual accuracy, depth, emphasis on skills building, action orientation, instructional soundness, and usability (NAAEE, 1996). The reviews conducted thus far suggest that many of these materials continue to address only a limited number of the goals of EE. On the whole, the curriculum materials seem to focus primarily on strong environmental science content. While some address the examination of environmental issues, few provide an opportunity to develop the skills necessary to define issues, analyze their underpinnings, and evaluate potential action strategies.

Upon reflection of the conclusions I made in the article and my experiences over the past six years since its publication, two issues need to be raised. First, there is a real need for the field of environmental education to establish an agreed upon, comprehensive, cohesive vision for practice. Environmental education has meaning, but that meaning is diluted when our research and practice do not reflect it. Similarly, it is time to recognize that most centers, curriculum materials, and schools do not provide a comprehensive environmental education program. It is not even realistic to expect a particular nature center, zoo, or museum to provide a total environmental education program within the context of the typical school visit. Likewise, a single piece of curriculum will, in all likelihood, not provide a total program. We need to start thinking about how comprehensive programs can be built using all of the resources available to the school. Nature centers, zoos, and museums can play an important, if not essential role, in this process. But environmental literacy is the product of schooling that begins at the very earliest years and continues into adulthood. If the various providers of environmental education experiences and materials do not work collaboratively to construct a well conceived, sequential program, we will be left with a series of unrelated, piecemeal events in a child's life. These disjointed learning experiences cannot be expected to result in the development of an environmentally literate citizen.

Bora Simmons
February 1997

Reference

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> *I am more project oriented than I ever was. And it also forced me to look at local stuff. I mean, that's what I focus everything on. I never, from the start - I never really wanted my kids to do, you know, like the dolphins or those kind of global issues. We were always trying to do local Joppatowne High School issues or county issues - things that were localized. . . .. It's moved me away from being the only person doing the directing and learning.*
>
> *I do very little lecturing - that sage on the stage thing! It kind of makes you tend to have them [the students] take over more. I do a lot more group work and things like that.*
>
> *. . . Since it places such an emphasis on the kids doing, directing their own learning, and them determining what information they need and how to go get it . . .. I think what it did was transfer [that same kind of learning] to other things.*

A Maryland High School Earth Science Teacher. After being asked the question, "Did using the issue investigation and evaluation approach change your teaching?" in an interview conducted by Versil Withrow, Workshop Coordinator for The Center for Instruction, Staff Development and Evaluation, 1997.

An Analysis of an Anti-Environmental Education Article: "The Globalist Children's Crusade"

John Ramsey

In this 1997 reading, Dr. Ramsey critiques an article that is extremely critical of environmental education. The article, "Globalist Children's Crusade" attacks EE from a number of standpoints. Dr. Ramsey states that, "The [article's] theme appears to be that EE is unscientific, parent-bashing, secular religious, globalist and Big Government propaganda that indoctrinates children into a deep commitment of environmentalism." Interestingly, Dr. Ramsey also points out that the research indicates that there is no national commitment to environmentalism on the part of the nation's youth. Be that as it may, it is most interesting to observe how Dr. Ramsey is able to redress the attack on EE while, at the same time, acknowledging that environmental education and its practitioners are not at all perfect.

A growing literature critical of American environmental education exists (e.g., Adler, 1992; Holt, 1991; Kwong, 1995; Mano, 1989; Novak, 1989; Poore, 1993). This report examines the claims offered in one such document. Entitled the "Globalist Children's Crusade," the article appeared in the *New American* (Grigg, 1993). An analytical examination of its claims and their rationales is both crucial and revealing for environmental educators. We probably need to know what our critics are saying to determine its validity. Overall, the article attacks EE curricular programs, federal and state EE policies and programs, the Gaia hypothesis, and scientific data about the environment. The theme appears to be that EE is unscientific, parent-bashing, secular religious, globalist and Big Government propaganda that indoctrinates children into a deep commitment of environmentalism.

The article appears in a special edition of the periodical called *The Resilient Earth*, with a caption reading "Far from being fragile, our planet is a vast and versatile creation designed to flourish under man's innovative stewardship." Grigg's article includes both educational, scientific, and political dimensions, all of which are cast from a politically conservative perspective.

In general, the author uses sarcastic inaccuracy, omission and distortion to inform and persuade his audience. The article reflects a lack of basic research and understanding of the basic theoretical underpinnings of EE. It advances its claims using unbalanced interpretation, inappropriate assignment, and faulty assumptions. The article also includes several agenda-driven drawings, one depicting a schoolhouse with a name sign reading "Church of Gaia Grades K-12" and another with a book entitled "1001 Things Kids Can Do To Keep the Planet From Blowing Up by Mae B. Greenhouse." Several of the claims presented will be considered.

Global Warming Claim

Let's first consider the only reference to scientific findings presented in the article, that pertaining to global warming. Thus, it is the most easily evaluated. Grigg states that there is "no firm evidence that significant warming has occurred" and that environmental programs focus on empowering children, not reliable facts (p.46). This portrayal of global warming is inaccurate. Many reputable sources and scientists have published data in the world's scientific literature that the earth is warming, e.g., Brown, Lenssen, and Kane (1995, *p.64-65)* among many sources. These authors state that "during the last century the clear trend is upward.

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Global temperature is 0.3-0.6 degrees Celsius above what it was in 1880" (p.64).

Thus, the evidence is "firm" and factual. The observed warming trend has lead to a prediction by the Intergovernmental Panel on Climate Change (IPCC) sponsored by the United Nations that global temperature will reach between 16 and 19 degrees Celsius by 2050, an extremely rapid warming by past standards. All extrapolated predictions are risky to an extent, and this prediction is based on the continued rise in the use of fossil fuels worldwide. Grigg presumably would discount this prediction because of its globalist source, the United Nations.

The issue surrounding global warming is not "what" but "how" and "why." That is, the debate centers on the theory of greenhouse gas buildup and based on the correlation between increasing temperature and increasing carbon dioxide in the air. Brown et al. claim that most climatologists give some validity to this theory, with vocal dissent by a few mavericks in the field - some of whom are sponsored by energy interests.

Overall, Grigg claims that the environmental movement is too "empirically impoverished to be considered scientific" (p.47). Grigg's use of science is inaccurate and denies or unwarrantedly dismisses the validity of the consensus work in this field. This strategy impoverishes his position.

The Children's Crusade: A Central Theme

The central, pervasive premise of the article is that EE is a modern children's crusade, much like the historical Children's Crusade of 1212 AD where seven shiploads of children were sent to "the Holy Land to convert the Saracens though the strength of their example" (p.44). Ultimately, the children were either shipwrecked and drowned or sold into slavery. Grigg claims that environmental educators are "activists [who] indoctrinate children, who in turn "educate" their parents and the public" (p.45). Further, it is claimed this strategy is manifest in EE curriculum, policies and programs; selected examples are provided as evidence.

The implications of this premise are that children know better than parents and adults; that parents and adults are pawns to children's manipulations; that EE is hostile to traditional family values and institutions; and that children are being shepherded into mental and emotional slavery. Thus, Grigg would have the readers believe that EE focuses on a political end using the unscrupulous and unethical control of children. And because children are the province of public education, it is the educators at all levels who are at fault. Wow! Let's consider these implications.

History

The children's crusade premise is not without historical precedent. Social reformers in the nineteenth century concerned about the use and abuse associated with child labor in the emerging factories of the Industrial Revolution also suffered the same attack. Probably, the economic and social implications of that reform served as the threatening motivation for that criticism, just as it does for Grigg-like thinkers of today's world. Child labor and environmental degradation were two historic strands of industrialization. Child labor, a more visible condition, served as an initial reform target while it took decades for the cumulative effects of environmental degradation to become manifest and understood. Child labor, still present in some underdeveloped countries, has been eradicated in industrialized countries, but as a global society we continue to struggle with the precept of environmental sustainability and its implementation. The environmental movement of the last several decades is currently suffering at the hands of a vocal societal faction which has regressed into public egoism with its allied social, political, and economic dimensions. Clearly, the clever children's crusade metaphor stimulates emotional resonance for those individuals who wish to walk away from the complexities and problems of modern society.

> **The environmental movement of the last several decades is currently suffering at the hands of a vocal faction who have regressed into public egoism with its allied social, political, and economic dimensions.**

EE in American Schools

Grigg's treatment of this topic implies that EE is a widespread educational activity throughout the United States. Using Wisconsin as an example, he cites the invasion of EE into the classroom and school system via state government, at the cost of individual and parental rights. In fact, there is very little EE in American schools. Very few states have established a formal niche for EE curricula and program (Kirk & Wilke, in press). These authors also indicate that only eleven states have an EE master plan, seventeen states have learner outcomes and objectives, fifteen states have curriculum guides, and only two states require preservice EE teacher training. For example, in Texas the only EE-related course available to students is environmental science, a high school elective that serves as a dumping ground for lower achieving students in need of a graduation credit. Environmental science and EE are two distinct disciplines. Thus, there is not the crusade effect claimed, because formal EE is not systematically delivered in American schools. Grigg's claim is full of sound and fury, signifying little.

The lack of systematic nationwide EE is a real problem. On one hand, the accepted goals of EE (discussed later in this report) cannot be achieved without EE implementation. On the other hand, EE treatments, where and when they are attempted, are often episodic and sometimes ill-conceived. Thus, it is possible that there are isolated cases of overzealous teachers "bandwagoning" children. It is further quite possible that these teachers have not had formal EE preservice or inservice training. The EE literature fails to address this type of data and that is perhaps an oversight on our part.

EE as a Political Agenda

Several policy documents providing a basis for discussion are present in the EE and science education literature. These documents offer several central themes of EE, of which personal and social decision making are the most common.

For example, the recently-published Science Standards (National Research Council, 1996) presents four goals of science education, two of which are pertinent to this discussion. Students should be able to:

- use appropriate scientific processes and principles in making personal decisions; and
- engage intelligently in public discourse and debate about matters of scientific and technological concern. (p.13)

Thus, personal and social decision making are seen as ultimate goals of science education. Grigg would have readers believe that these frame a political agenda, as opposed to a citizenship goal. And citizenship, along with literacy, in tandem form the foundation of American education. [Refer to Ramsey (1994) for a review of social responsibility in the context of scientific literacy.]

The lack of systematic nationwide EE is a real problem. On one hand, the accepted goals of EE . . . cannot be achieved without EE implementation. On the other hand, EE treatments, where and when they are attempted, are often episodic and sometimes ill-conceived. Thus, it is possible that there are isolated cases of overzealous teachers "bandwagoning" children. It is further quite possible that these teachers have not had formal EE preservice or inservice training.

Grigg is also ignorant of or ignores basic definitions of EE. Let's revisit this literature. The Environmental Protection Agency defines EE as

> the process that leads citizens to responsible individual and group actions. Environmental education should enhance critical thinking, problem solving, and effective decision making skills and should engage and motivate individuals as well as enable them to weigh various sides of an environmental issue to make informed and responsible decisions." (1992, p.47516)

Further, The North American Association for Environmental Education defines EE as

> the process that aims to develop an environmentally literate citizenry that can compete in the global economy, that has skills, knowledge and inclinations to make well-informed choices concerning the environment, and that exercises the rights and responsibilities of members of the community." (1996, p. 2)

Here, again, decision making and citizenship are identified as central outcomes. Although many other sources could be offered in this discussion, those definitions presented above highlight that EE focuses on process, not product. For example, EE students are not told (or indoctrinated) to cut the tree or to save the tree. Rather, they are to be educated to factor in environmental considerations, making comprehensive informed decisions as citizens. [Refer to Hungerford et al. (1996) for a more complete view of this decision making process.]

Is EE political? Only to the extent that it advocates the rights of citizens and informed participation in democratic processes, one of the basic tenets of the American public education process. In rebuttal to Grigg, there is no conspiracy or overarching political scheme. Grigg would have schools defend and perpetuate his view of the status quo as opposed to preparing students for the future.

Political Agendas of EE Curriculum

Grigg claims that EE curriculum empowers and mobilizes children for a political agenda (p.44). As the only evidence, *The Kid's Guide to Social Action* (Lewis, 1991) is cited. This volume includes activities such as survey methods, persuasion skills, petitioning, fundraising, and media communications. According to Grigg, these activities "require a cultivated disregard of parental authority" (p.45). He finds it particularly pernicious that children are instructed to seek information from environmental lobbies such as Greenpeace, Friends of the Earth, Planned Parenthood, and the Model United Nations.

However, he failed to note that the Lewis book also lists many other sources of information, including government and business. For example, Lewis includes Young Americans for Freedom, Future Farmers of America, International Christian Youth, and Religious Heritage of America. This balance is not reported in Grigg's slanted omission. In general, Grigg assigns a solely environmental cast to the Lewis book. In fact, it attempts to build children's awareness, skills, and motivation to exercise their participatory rights in any type of social issue. The Lewis book's advocacy position is aimed at the same rights, responsibilities, and outcomes identified in the EE definitions presented above. However, in fairness, it does not include a rational, data-based decision making model similar to that offered by Hungerford et al. (1996). Thus, it is strong in terms of participation outcomes (the ends) but weaker in terms of decision making processes (the means).

EE and Children-Adult Relationships

Grigg frequently contends that children manipulate adults in environmental matters; that EE frequently confronts and undermines parental rights and authority; and that school children are ignorant of math, reading, and history but have a bone-deep commitment to environmentalism. He would have us believe that masses of children are telling their parents and other adults what to believe and do with respect to the environment. There is no evidence that indicates that American youth have a deep concern about the environment, much less an overriding political agenda.

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Recent research of environmental literacy in children find environmental apathy (Bluhm et al., *1995).* Primary concerns and interests center around social and recreational dimensions. For example, Key (1995) found that sports was very important and that the environment was relatively unimportant for a population of middle school students. Most children are interested and concerned about their social worlds - their friends, families, school, and recreational activities. There is not a deep knowledge of or passion for the natural world, and there is not a deep involvement in environmental issues. This is unfortunate from my viewpoint, but the assumption on which Grigg's claim is based is groundless. And it follows that EE cannot be a threat to parents and their rights. Again, the data indicate the lack of and a need for formal school-based EE.

EE as Secular Religion

Grigg contends that the Gaia Hypothesis is the secular religion of EE. Here he fuses aspects of the environmental movement into EE but fails to develop and document that infusion. His assumption is that a well-known dimension (Gaia) of the environmental movement must has been translated into EE curriculum and instruction simply because it exists. His evidence includes cable television programs and the computer game "SimEarth," reputed examples of EE. The connection or relationship between these deliveries and EE is beyond my grasp. The ties were not established. This secular religion topic simply provided the author a convenient forum to rail against a perceived religious threat.

Summary

The EE movement in the U.S. has been under attack recently at many levels. The Grigg article reflects one of these perspectives. It represents a clever piece of persuasive writing, probably aimed at inciting a target audience already sensitized to its message. An analysis of the article's claims and evidence finds it uses inaccuracies and faulty assumptions to create a non-existent reality. It might "make sense" for an audience predisposed to conventional wisdom, but it fails to attain solid journalistic or scholarly standards. It is, however, a real look at how an extremist segment of the population views our efforts, and they represent and imply, in my opinion, both social and environmental regression. Hopefully, these opinions are not shared by the majority of our citizens.

It is also to our advantage to heed Simmons' advice about avoiding EE indoctrination (1996). She asserts that EE provides an appropriate context for teaching citizenship by emphasizing both rights and responsibilities. Further, she notes that criteria have already been established in *Environmental Education Materials: Guidelines for Excellence.* These curricular/instructional criteria include factual accuracy, balanced presentation of differing viewpoints, openness to inquiry, reflection of diversity, focus on concepts and their context, critical and creative thinking, the application of skills to issues, and the development of citizenship action skills. This is, indeed, good advice!

It is also to our advantage to heed [Bora] Simmons' advice about avoiding EE indoctrination (1996). She asserts that EE provides an appropriate context for teaching citizenship by emphasizing both rights and responsibilities.

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Goals and Competencies for Precollege STS Education: Recommendations Based upon Recent Literature in Environmental Education

Peter A. Rubba and Randall L. Wiesenmayer

In this article, Drs. Rubba and Wiesenmayer compare STS instruction with a goal structure for environmental education. Noting substantial goal similarities, they construct a set of goals for precollege STS education based on The Goals for Curriculum Development (1980) and the research which followed that theoretical model (much of which is discussed in this readings book). As the authors state, ". . . learners are most likely to become active in the resolution of STS issues if the STS education they receive includes the study of issue investigation skills and strategies that can be applied toward the resolution of STS issues along with the opportunity to apply them." This is in complete agreement with the research which has been conducted into issue investigation and evaluation outcomes in EE.

Since being endorsed by the blue-ribbon groups that examined the status of science education in the United States during the early 1980s (Aaronian and Brinckerhoff 1980; Harms and Yager 1981; NSTA 1982; NSB 1983), science-technology-society (STS) education has become a focus of activity in science education. At the state level, departments of education have moved to structure goals and objectives, curriculum guidelines, course requirements, and teacher certification standards for precollege STS education. Florida, Maryland, Michigan, New York, Washington, and Wisconsin stand out as leaders in promoting precollege STS education by having initiatives of this type in place. Other states, such as Illinois, Indiana, and Pennsylvania, are in the process of developing and implementing similar STS education initiatives (Rubba, Barchi, and Wambaugh 1987).

At the teacher-training level, STS education is becoming a common topic in preservice science methods courses. A number of institutions, among them the University of Iowa, Pennsylvania State University, and Southern Illinois University, offer workshops in STS education for inservice teachers. Between 1983 and 1986, eleven proposals with STS components were funded by the National Science Foundation under its Teacher Enhancement Program (Strassenberg 1987).

Science teachers have reacted to the calls for STS education by infusing STS into extant science courses, irrespective of whether state or local mandates exist. STS courses have become an attractive option in states and districts that now require two or more years of science for high school graduation. These courses are being developed locally by science teachers or groups of science, social studies, and humanities teachers.

Individual instructional material developers and commercial publishers recently have begun to respond to the STS movement with the introduction of textual materials that include an STS flavor and the publication of separate STS modules. Still, fiscal limitations appear to be the most significant barrier to the wider implementation of STS, especially as these influence the purchase or development of STS curricula (Bybee and Bonnstetter 1987).

Individual instructional material developers and commercial publishers recently have begun to respond to the STS movement with the introduction of textual materials that include an STS flavor . . .

Despite some early opposition (Good, Herron, Lawson, and Renner 1985), it appears that STS education has been adopted as a viable part of the precollege science curriculum in the United States. Examination of extant documents and materials

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relevant to STS education at the precollege level (e.g., state documents, syllabi, and texts used in science teaching methods courses and workshops, along with precollege curriculum materials) shows a prevalence of examples that align with the social responsibility perspective of STS education that emerged from the blue-ribbon reports and that since has become the most broadly accepted.[1] However, the few snapshots we have of STS educational practice show a much less complete implementation.

In studies conducted by Rubba (1986) and Rubba and Wambaugh (1987), secondary (grades seven to twelve) science teachers from Illinois and biology and life science teachers from Pennsylvania were asked what STS issues they were including in the science courses they considered to be their specialty, and what instructional procedures they were using to do so. The reported STS issues infused by teachers into their science instruction were few in number and rather predictable. On average the Illinois teachers reported infusing 2.5 STS issues into a science course. Within the Pennsylvania sample the average was 4.8 STS issues per course.

Except for pollution-related STS issues, which were dealt with in all science courses except physics, the issues varied among the teachers by science area taught. Nonetheless, the STS issues tended to be the high-visibility global or national ones, not necessarily STS issues that were of local or regional concern. Land use issues were popular with earth science teachers, as were energy use issues with physical science and general science teachers. Genetic engineering-related and environmental issues of all types were focused upon by the life science, biology, and advanced biology teachers. The chemistry and physics teachers centered on STS issues related to nuclear power generation and nuclear warfare.

The instructional procedures the science teachers used to deal with these STS issues were as limited as the scope and number of the STS issues themselves. The lecture and class discussion approaches dominated in both samples, with films, slides, and videos next in order of use, followed by the laboratory.

Illinois sample members were asked to specify the percentage of science class instructional time they believed should be dedicated to preparing students to deal with science-and-technology-related societal issues. On the average the teachers recommended 15 percent, a value that is close to those recommended by Aaronian and Brinckerhoff (1980) and the National Science Teachers Association (NSTA 1982), but one that none of the teachers themselves came close to fulfilling.

While it is not claimed that the findings from the two studies are representative of science teachers in general, that suspicion is expressed (Rubba 1986). Given that preservice and inservice science teacher education has, for the most part, focused since the mid-1950s on helping science teachers develop the capabilities to teach science for the goal of academic preparation (Harms and Yager 1981), and given the relative newness of STS education to precollege science education, it is highly probable that science teachers are using traditional instructional procedures to bring STS education into the science classroom simply because they are familiar with those procedures. It also might be because they believe the discussion, lecture, media, and lab are appropriate for STS education. Both speculations imply misconceptions on the part of teachers concerning the goals of STS education at the precollege level.

Purpose

In this article, we seek (1) to provide a brief overview of why STS education (approached from a social responsibility perspective) should be included in precollege science education; (2) to summarize selected recent literature on environmental education that has implications for precollege STS education and present a set of goals for STS education that follow from that literature; and (3) to further explicate the goals as a set of student competencies that might be used to guide precollege STS education in selected grades.

Precollege STS Education: A Rationale Taken from the Social Responsibility Perspective

Since primitive man first used a common object as a tool, humans have been faced with decisions on issues that involve technological developments. As our science and technology became more complicated, pervasive, and powerful, particularly during the past quarter century, the ability to make responsible decisions on scienceand-technology-related societal issues and take action toward their resolution has become more important. A few million years ago a technology-related decision might have involved deciding whether to hunt with a club or rock, and it would have affected relatively few people. Today, the issues, the method selected for resolution, as well as the method's consequences, can be momentous, affecting large numbers of human beings sometimes for generations.

Modern citizens face decisions on issues arising out of the interactions of science, technology, and human values every day of their lives, in areas such as environmental quality, health and medicine, national security, waste management, and world population-on issues such as food additive use, energy consumption, toxic waste disposal, land use, high-tech equipment in the workplace, acid rain, AIDS, genetic engineering, world hunger, overpopulation, and nuclear proliferation. Some of these issues confront us at the personal level (e.g., use of food products that contain certain additives, energy consumption); others we face both at the personal level and as members of society (e.g., acid rain, nuclear proliferation).

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As members of a democratic society, we have the right, and some would argue the obligation, to participate in the resolution of those issues, which affect segments of society or society as a whole.

As members of a democratic society, we have the right, and some would argue the obligation, to participate in the resolution of those issues, which affect segments of society or society as a whole. We can do so through the election of and communications with governmental representatives, or by direct participation in societal affairs - by running for office, by speaking out at public meetings, by joining civic groups, by participating in demonstrations, or by contributing to organizations that sponsor action.

The blue-ribbon groups that examined science education in the United States during the early 1980s (Aaronian and Brinckerhoff 1980; Harms and Yager 1981; NSTA 1982; National Science Board (NSB 1983) recognized the numerous science-and-technology-related societal issues facing humankind and realized that thorough consideration and thoughtful action by a large segment of our citizenry will be required if they are to be resolved satisfactorily. It was also clear to the panel members, however, that such action is the exception rather than the rule.

American adults show a high level of interest in new inventions and technologies and place a great deal of faith in their power. At the same time, the vast majority of citizens lack the capabilities needed and the will to deal with science and technology as it touches our everyday lives, and so do not. Six out of ten Americans in 1982 believed that science and technology have caused more good than harm, and that most of the economic and social problems we face will eventually be solved by new technologies (Disinger 1986; NSB 1985).

This relegation of responsibility for the resolution of science-and-technology-related societal issues to technology is alarming. But even more so are its secondary effects. The inability and unwillingness of the majority of citizens to deal head-on with science-and-technology-related societal issues create an atmosphere in which action on these issues by individual citizens or groups automatically takes on the hue of radicalism. In addition, this situation places undue burdens upon those few who take action, opens the door to the influence of special interests, and possibly ensures the uncontrolled proliferation of technology.

The blue-ribbon reports recommended that school science programs move away from the singular emphasis on academic preparation, which has dominated precollege science education since the early 1960s, and give comparable emphasis to helping students develop the abilities needed to act on science and technology as they interface with our everyday lives. The integration into the school science curriculum of STS education approached from a social responsibility perspective-for the purpose of helping students develop the knowledge, skills, and affective qualities needed to take responsible action on STS issues - was strongly endorsed

(Aaronian and Brinckerhoff 1980; Harms and Yager 1981; NSTA 1982; NSB 1983).

Recent Literature in Environmental Education and a Goal Structure for STS Education

The STS education literature is rich with papers, such as the proceedings of the First Technological Literacy Conference (Waks 1986), that tout the virtues of STS education and recommend its inclusion in the precollege curriculum. The literature, however, is sparse when one seeks curricular and instructional guidance for precollege STS education. This weakness and its possible ramifications have been clearly enumerated (Rubba 1987a).

> **The literature . . . is sparse when one seeks curricular and instructional guidance for precollege STS education. . . . there is a substantial body of literature in the area of environmental education EE), over a decade in the making, that has direct implications for precollege STS education approached from the social responsibility view-point.**

Volk (1984) and Disinger (1986) have each presented arguments that suggest that environmental education is, in fact, STS education. These arguments notwithstanding, there is a substantial body of literature in the area of environmental education (EE), over a decade in the making, that has direct implications for precollege STS education approached from the social responsibility viewpoint. Four recent EE studies of responsible environmental action (Klingler 1980; Hines 1984; Ramsey, Hungerford and Tomera 1981; Sia, Hungerford, and Tomera, 1986) and a goal structure for EE (Hungerford, Peyton, and Wilke 1980), in particular, have significant implications for precollege STS education.

Selected EE Research

Factors that contribute to responsible environmental behavior (action) have been the topic of intensive study among environmental educators for over a decade. Two recent studies, completed in 1984 by Sia, Hungerford, and Tomera (1986) and Hines (1984), sought to consolidate that body of research by determining the contribution made by particular variables noted in the EE literature toward predicting the environmental behavior of responsible citizens.

Sia, Hungerford, and Tomera (1986) used regression analysis to examine the contribution made by eight variables prominently noted in the EE literature to responsible environmental action among high and low environmental behavior groups. Members of the Sierra Club and an elderhostel group (the subjects) completed a battery of instruments. Analysis of the data showed seven variables to be statistically significant contributors to responsible environmental action: (1) level of environmental sensitivity, (2) perceived knowledge of environmental action strategies, (3) perceived skill in using environmental action strategies, (4) psychological sex role classification, (5) individual locus of control, (6) group locus of control, and (7) attitude toward pollution. The first three of these seven statistically significant variables were found to be responsible for 49.24 percent of the variance in responsible environmental behavior. An eighth variable, belief in technology, was not found to be a statistically significant contributor to responsible environmental behavior.

Hines (1984) conducted a metanalysis of 128 recent EE studies on responsible environmental action to determine which variables were associated with environmental action and the relative strengths of the relationships. Her analysis revealed six variables to be strongly associated with responsible environmental behavior: (1) verbal commitment (intention) to take action ($r = 0.49$), (2) internal locus of control ($r = 0.38$), (3) environmental efficacy perception (belief in one's ability to help alleviate environmental problems) ($r = 0.36$), (4) attitudes toward the environment ($r = 0.35$), (5) a personal sense of responsibility for the environment ($r = 0.33$), and (6) knowledge about the environment (e.g., ecology) ($r = 0.30$).

From the research of Sia, Hungerford, and Tomera (1986) and Hines (1984), it appears that responsible environmental action is mainly a function of four factors: (1) knowledge of environmental issues, (2) knowledge of specific action strategies that might be applied to resolve an environmental issue, (3) the ability to take action on environmental issues (actually applying the action strategies), and (4) the possession of certain affective qualities and personality attributes. The first three of these four factors, the cognitive ones, were clearly predicted in 1980 by Hungerford, Peyton, and Wilke in a set of goals for EE that were later construct validated in research by Ramsey, Hungerford, and Tomera (1981) and Klingler

(1980), as well as by the studies conducted by Sia, Hungerford, and Tomera (1986) and Hines (1984).

Hungerford et al. (1980) proposed a hierarchical goal structure for EE that had as its superordinate goal the development in citizens of the ability and desire to take responsible environmental actions. Four sequential levels of EE were presented subsidiary to that superordinate goal.

At Level I, the Ecological Foundations Level, EE seeks to provide a learner with ". . . sufficient ecological foundations knowledge to permit him or her to eventually make ecologically sound decisions with respect to environmental issues" (p.43). A list of crucial ecological issues (e.g., ecosystem, homeostasis, limiting factors) are presented within the goal statement.

Level II EE, the Conceptual Awareness Level, is directed at helping learners become cognizant of the variety of environmental issues facing humankind and the role played by differing human values and beliefs in their remediation. Level II also helps learners to understand that only through citizen action will these issues be resolved.

At Level III of the Hungerford et al. goal structure, the Issue Investigation and Evaluation Level, EE instruction aims to provide learners with the knowledge and skills necessary for them to investigate and evaluate alternative means for the remediation of environmental issues. Instruction is provided in areas such as issue identification and investigation, analysis of associated value positions, identification of possible alternative solutions, and the evaluation of these. Then, learners are given an opportunity to put these skills into practice in the investigation and analysis of environmental issues.

Level IV EE, Environmental Action Skills Training and Application, seeks to develop in learners those skills needed to take positive action on environmental issues. Here, learners would gain knowledge about actions that fit into consumer, legal, persuasion, political, and physical (eco-management) categories. (Civil actions, such as civil disobedience, are not noted.) Learners are also provided with opportunities to apply these actions to environmental issues and evaluate their effectiveness.

The important affective qualities for environmental action that follow from the work of Sia, Hungerford, and Tomera (1986) and Hines (1984) were also foreseen in the goal structure, though not as completely. Environmental sensitivity is noted as being critical to an individual's willingness and ability to investigate and take action on environmental issues. Hungerford, Peyton, and Wilke suggest that ecological foundations instruction (Level I) be provided to learners prior to or concurrent with instruction at the other three levels, with the instruction for those three levels presented either sequentially or integrally.

The content validity of the Hungerford, Peyton, and Wilke (1980) goals structure for EE was originally confirmed by a panel of experts. Empirical tests of its construct validity were provided by Ramsey in 1979 (Ramsey, Hungerford, and Tomera 1984) and Klingler (1980). In both studies, the effects of EE instruction at the various goal levels on the environmental actions taken by junior high school students were compared.

Each study involved three treatments: (1) one group received "environmental case study instruction" limited to Goal Levels I and II, (2) a second group received "environmental issue investigation and action instruction" that included Goal Levels I through IV, and (3) a third group served as a control, receiving life science instruction. The results revealed that those students who received the environmental issue investigation training and action instruction, which included opportunities to apply those skills to an environmental issue, showed statistically significant higher levels of overt environmental action (actions independent of class activities) than did the students in the other two groups. A follow-up by Ramsey of the participants in his study three years later revealed that the group differences continued.

The Implications for STS Education

The work in EE of Hungerford, Peyton, and Wilke (1980), Ramsey et al. (1981), Klingler (1980), Hines (1984), and Sia, Hungerford, and Tomera (1986) has powerful implications for precollege STS education. This literature strongly suggests that if precollege STS education aims to help students develop the capabilities to make discriminating decisions on STS issues and take action on those decisions (a social responsibility view), then STS education cannot be limited to the type of curricular and instructional activities one would find at the foundations and awareness levels of EE. That is, providing learners with an understanding of the science concepts and technology that underlie an STS issue is important but probably will not by itself lead to action on STS issues by learners. It also follows that it is not sufficient for STS curriculum and instruction to assist learners in the process of exploring and clarifying their attitudes and values toward science-and-technology-related societal issues (e.g., class discussions). Neither is it enough for STS education merely to emphasize STS issue identification or account example issue resolution (e.g., case histories/studies).

The clear implication in this EE literature is, if STS education is to guide learners in the development of the knowledge, skills, and affective qualities needed to make decisions and take actions on STS issues in a responsible manner, now and in the future, STS education must directly address these capabilities. Learners must develop the capabilities to investigate and take action on STS issues. This means going beyond use of classroom discussions, lectures, audio-visual resources, and lab exercises.

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A Goal Structure for Precollege STS Education

Given that the "Goals for Curriculum Development in Environmental Education" presented in Hungerford, Peyton, and Wilke (1980) are based upon a social responsibility model of EE, it appears that they are an appropriate model for STS education. Rubba and Wiesenmayer (1985) adapted the Hungerford et al. hierarchy to precollege STS education, yielding a four-level goal structure for precollege STS education in which the superordinate goal of precollege STS education is ". . . to aid citizens in developing the knowledge, skills and affective qualities needed to make responsible decisions on STS issues, and to take actions on those decisions toward resolution of the issues" (p.577). The subsequent goal levels are Level I, the STS Foundations Level, Level II, the STS Issue Awareness Level, Level III, the STS Issue Investigation Level, and Level IV, the STS Action Skills Development Level. Each is discussed below.

STS curriculum and instruction at Level I, the STS Foundations Level, would provide learners with sufficient background knowledge regarding (1) concepts in the natural sciences and social sciences, (2) the nature of science and technology, and (3) the characteristic interactions among science, technology, and society to enable them to make informed decisions on STS issues. Natural science concepts that cut across the respective biological, earth, and physical science disciplines, such as change, field, interaction, model, and system, would be good candidates for study. Social science concepts from anthropology, economics, psychology, and sociology, such as attitude, behavior, belief, institution, culture, social structure, society, and values, would be appropriate. At this level, learners would develop an understanding of the nature of science and technology, their similarities and differences, and their interdependence, as well as become cognizant of the typical interactions that occur among science, technology, and society.

At Level II, the STS Issue Awareness Level, learners would become cognizant of how the interrelationships among science, technology, and society sometimes result in issues that must be resolved by examining all sides of the issue, associated human beliefs and values, and alternative solutions for resolving the issues, and then by taking action. A major thrust at this level would be to promote an understanding of the effects of factors, such as religion, politics, economics, and personal interest, on the ways STS issues are viewed. Learners would be made aware of the complexity of STS issues facing humankind, the impact of those issues and possible alternative solutions, and the need for responsible individual and group actions.

Instruction at Level III, the STS Issue Investigation Level, would develop in learners the knowledge and skills to enable them to investigate STS issues and judge the efficacy of possible solutions with respect to various value positions. STS education directed at Level III would have two components. The first would encompass training with problem investigation skills, such as problem identification and statement, use of secondary sources, data collection via primary sources (natural or social science instruments), data interpretation, and drawing conclusions. The second component provides the opportunity for learners to apply these skills in the investigation of STS issues.

At Level IV, the STS Action Skill Development Level, STS education would seek to develop skills in learners that they could use, working individually or in groups, to take action on STS issues. This would again include instructional activities designed to develop an understanding of actions that might be taken from a number of categories (e.g., civil, consumer, legal, persuasion, physical, political) and would also include opportunities to take actions toward the resolution of an STS issue and to evaluate the effectiveness of those actions.

Competencies for Precollege STS Education

The STS education goal structure presented by Rubba and Wiesenmayer (1985) is a curriculum and instruction view of precollege STS education. But, what does the goal structure mean in terms of learner capabilities and performances? That question was partially addressed by Rubba (1987b) through the presentation of the following fifty-three student competencies for students in grades seven through twelve.

STS Foundational Competencies

At this level the student will be able to

1. state a definition of science that characterizes it as an empirical inquiry process,
2. describe the nature of scientific laws, theories, concepts, or factual statements,
3. classify scientific explanations as laws, theories, concepts, or factual statements,
4. apply basic natural science laws, theories, and concepts in problem-solving situations,
5. apply basic social science laws, theories, and concepts from anthropology, economics, psychology, and sociology as these impinge upon STS issues,
6. define technology in terms of a socio-technical system of use,
7. identify examples of technological development,
8. distinguish between examples of science and technology,
9. describe the characteristic interrelationships that exist among science, technology, and society,
10. name examples of the interaction between science and technology and describe the nature of the interaction,
11. name examples of the interaction between science and society, and describe the nature of the interaction, and
12. name examples of the interactions between technology and society and describe the nature of the interaction.

STS Issue Awareness Competencies

The student will be able to

1. state a definition of an STS issue,
2. distinguish between examples and nonexamples of STS issues,
3. name current STS issues that have significance at the local, national, or global level and describe why the issues are significant,
4. assign priority to STS issues in terms of their local, national, or global significance and justify the assigned priority,
5. identify the various value positions associated with an STS issue and characterize those positions,
6. identify and describe the system of scientific and social beliefs that found the respective value positions associated with an STS issue,
7. identify the natural science laws, theories, or concepts that impinge upon an STS issue,
8. identify the social science laws, theories, or concepts that impinge upon an STS issue,
9. identify the technological development(s) that impinge upon an STS issue,
10. describe the complex of science, technology, and social interactions that characterize an STS issue and attempts to resolve the issue,
11. express the belief that responsible individual or group action(s) is necessary if an STS issue is to be resolved,
12. explain why there exists a variety of possible courses of action that might be taken on an STS issue, and
13. predict STS issues that could arise in the near future as a result of the interactions between cutting-edge science or technology and society.

STS Issue Investigation Skill Competencies

The student, at this level, will be able to

1. construct well-formed statements of STS issues,
2. use secondary sources to investigate STS issues,
3. use primary natural science data collection procedures to investigate STS issues,
4. use primary social science data collection techniques to investigate STS issues,
5. design and conduct a study to investigate an STS issue,
6. interpret data collected in the investigation of an STS issue,
7. draw conclusions from data collected in the investigation of an STS issue,
8. make inferences from data collected in the investigation of an STS issue,

9. predict consequences from the findings of an STS issue investigation,
10. make recommendations for the future course(s) of action on an STS issue based upon the findings of an investigation,
11. communicate the results of an STS issue investigation via an oral report,
12. communicate the results of an STS issue investigation via a written report,
13. make a meaningful contribution to a group investigation of an STS issue, and
14. conduct an individual investigation of an STS issue.

> **If the goal of STS education is to be met, however, if we are to have a literate and functioning citizenry on STS issues, then STS education needs to be more than conceptual foundations and issue awareness. As the literature in EE suggests, learners are most likely to become active in the resolution of STS issues if the STS education they receive includes the study of issue investigation skills and strategies that can be applied toward the resolution of STS issues along with the opportunity to apply them.**

STS Issue Action Skill Competencies

At this fourth level, the student will be able to

1. identify examples of civil, consumer, legal, persuasion, physical, and political actions taken on STS issues,
2. classify examples of actions taken on such STS issues as civil, consumer, legal, persuasion, physical, and political actions,
3. identify alternative ends toward which an STS issue might be resolved,
4. identify the consequences associated with the resolution of an STS issue toward a particular end,
5. assign priority to the various ends toward which an STS issue might be resolved, and justify the assigned priority,
6. identify alternative action plans by which an STS issue might be resolved,
7. identify the consequences associated with using a particular action plan toward the resolution of an STS issue,
8. assign priority to the various action plans by which an STS issue might be resolved,
9. make a personal commitment to an STS issue that needs to be resolved,
10. implement action plans as part of a group toward the resolution of local, national, or global STS issues,
11. implement action plans on an individual basis toward the resolution of local, national, or global STS issues,
12. assess the effectiveness of actions taken toward the resolution of an STS issue, and
13. modify an STS issue action plan based upon an assessment of its effectiveness.

Conclusion

STS education is a growing component of precollege science education, one that aims to help learners develop the capabilities needed to participate as citizens in the resolution of the STS issues that we face as individuals and as members of society. If the goal of STS education is to be met, however, if we are to have a literate and functioning citizenry on STS issues, then STS education needs to be more than conceptual foundations and issue awareness. As the literature in EE suggests, learners are most likely to become active in the resolution of STS issues if the STS education they receive includes the study of issue investigation skills and strategies that can be applied toward the resolution of STS issues along with the opportunity to apply them.

NOTE

1. While not as common, one also finds examples that are aligned with each of the three "ugly stepsisters" (misconceptions) of STS education explicated by Waks and Prakash (1985)-the technical, rational-academic, and personal conceptions.

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The Science Education Reform Movement: Implications for Social Responsibility

John Ramsey

That every environmental issue is also an STS issue makes this article by Dr. Ramsey extremely important for environmental educators. Although much has been written in EE about citizenship behavior, we do not see a great deal about fundamentals of social responsibility, notwithstanding other topics which typically exist on the periphery of EE.

Dr. Ramsey makes some rather cogent points that some educators are often prone to forget. He writes: " All science students, however, will become citizens. All will be consumers of the products and services of science and technology. All will assume and be responsible for the benefits and risks of scientific and technological knowledge, products, systems, and services. All will be decision makers concerning matters of science and technology, either willfully via participation in democratic decision making or apathetically via the lack of such participation. . . . [science] education . . . is a socially driven enterprise and part of an educational system with a larger, democratic mission. . . . STS issues-based instruction has attempted to construct an appropriate means to achieve the much-sought end of social responsibility."

Introduction

Citizenship has been and continues to be an ultimate goal of the American educational enterprise. As a society, we believe that schools should prepare masses of people to exercise the rights and responsibilities of citizenship. Thus, social responsibility is an established general education goal, one that science education must no longer avoid. Science education cannot be sequestered in the laboratory; it must, to some critical extent, be an active part of our social milieu. The current science education reform movement, either intentionally or unintentionally, has not fully conceptualized the task at hand.

The premise of this report is that only one of the current reform movements, the science-technology-society (STS) effort, offers the potential for meeting the challenge of science for a general education. The following theses will be presented and defended: (1) science education, both at a national level and within school-based programs, has acknowledged or implied social responsibility as one of several critical foci, (2) the traditional discipline-focused science curriculum, as well as many of the proposed curricular changes in science education currently under development, cannot meaningfully address a social responsibility focus, and (3) both curricular and instructional STS approaches that foster social responsibility are available and effectively functioning in a number of diverse school-based science education programs across the country.

The debate in the current science education reform movement concerns the "what" of its curriculum and instruction. What are the appropriate outcomes? What are the appropriate contexts? What is the appropriate content? Tyler (1949) has stated that curriculum is an integration of the needs of society, the discipline, and the learner. The current reform dilemma is about how to integrate these three factors. This dilemma forms the basis of the following report. The discussion will first review the role of social responsibility within the science education community as a whole.

Social Responsibility and Scientific Literacy

As a community, science educators have identified social responsibility as a primary goal. This outcome is nested within a larger civic mission of American schools that has a long history, dating

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from Jefferson and Dewey and extending to modern day writers, e.g., Bragaw, 1992; Heath, 1989; Lazerson et al., 1984; Prewitt, 1983; Tanner, 1990). It is, to a great extent, a mission largely ignored by much of current science education practice. Much of the literature concerning social responsibility has been presented in the context of scientific literacy. Although an exhaustive review of scientific literacy is beyond the scope of this report, the following discussion will establish the relationship between scientific literacy and social responsibility. Subsequently, scientific literacy, in the context of STS will be discussed.

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Science for All Americans [American Association for the Advancement of Science, (AAAS), 1989], also called the Project 2061 Report, presented literacy goals for science, mathematics, and technology. The Project 2061 authors indicated that the reformation of schools and the reformation in society must take place concurrently. They state that:

> It is an admirable notion that better education is necessary for and can lead to a better America. But only if some of today's worst social problems are ameliorated will the schools be able to make sweeping reform steps that will enable them to have extensive positive effects on society. The reforming of education and the reforming of society need to go hand in hand. (p.158)

Given this posture, it is not surprising that Project 2061's definition of scientific literacy concluded with the phrase . . . "and being able to use scientific knowledge and ways of thinking for personal and social purposes" (p.20). The implied reconstructionist approach suggested by an organization such as AAAS is remarkable.

Project Synthesis (Harms and Yager, 1981) presented scientific literacy based upon four independent goal clusters: personal needs, societal issues, academic preparation, and career awareness. The implication of this approach was that the content of the science curriculum should be derived from many sources, including society, and it should be directed at personal, societal, and discipline-focused outcomes. Concerning the societal dimension, the report stated that science education should produce informed citizens prepared to deal responsibly with science-related social issues.

Miller (1983) and Prewitt (1983), writing in the scientific literacy theme issue of Daedulus, included a societal dimension in their reports. Miller's view of scientific literacy included three strands: understanding the scientific approach, understanding basic science concepts, and understanding basic science policy issues. The understanding of science policy issues was called "civic scientific literacy." His argument seemed to rest on the premise that the science policy-making process would function more effectively if the public were capable of understanding both the substance and the process of scientific arguments. In that it did not call for decision making, Miller's view of civic scientific literacy apparently was situated solely in the cognitive domain. That is, Miller assumed that scientific knowledge, in and of itself, would lead to appropriate outcome behaviors. As will be seen later, many in the STS community, particularly those focused on issues-based instruction, believe that the content knowledge-behavior relationship is tenuous (Hines et al., 1987; Hungerford and Volk, 1990; Ramsey et al., 1981; Rubba, 1990).

Prewitt presented a more comprehensive conception of scientific literacy. Prewitt acknowledged the traditional importance of scientific literacy in terms of economic growth, national prestige, and science policy issues. He, however, stated that scientific literacy originates in the interactions of science and society and fosters what he calls the "savvy citizen," an individual-although not a scientist or technologist-who is willing and able to cope with science-related decisions both at a personal and societal level. Thus, Prewitt's literacy view seemed to embrace cognitive, affective, and behavioral domains.

Prewitt further believed that his savvy citizen possessed a positive fate control orientation like that described by Rowe (1983). Fate control, according to Rowe, refers to a pattern of beliefs about the nature of the world in which we live, one's place in it, and the influence one can have on it. Individuals with a high, i.e., positive, fate control outlook function as if they believed that events evolve by processes they can discover and influence. Thus, they are more proactive because they believe that the future evolves from what one does in the present. We will see in a later section of this report that the notion of the savvy citizen who copes with science and technology in public life has been operationally defined by STS writers, particularly those interested in issues-based instruction.

Hetherington and Hetherington [Biological Sciences Curriculum Study and Social Science Education Consortium (BSCS/SSEC) 1992] offered a literacy triad that included practical scientific literacy, civic scientific literacy, and cultural scientific literacy. Practical scientific literacy consists of the knowledge and skills needed to maintain our way of life. Civic literacy deals with the meaningful participation in the democratic processes of our highly scientific society. Cultural literacy deals with the understanding of science as a major human achievement and an integral part of our general culture. Certainly, this composite view of scientific literacy offers a commendable balance. However, of the three literacies it was civic literacy, communicated in the phrase "meaningful participation," that was expressed in the behavioral domain. Further, the Hetherington view of cultural literacy also suggests a utility for another dimension of STS, the study of the history and nature of science and technology (HNST).

The discussion above indicates that social responsibility has an established life space in the scientific literacy literature. Further, it would seem that many scientific literacy writers view social responsibility in an overt, behavioral dimension, e.g., "meaningful participation," positive "fate control," "dealing responsibly," etc. This distinction is critical and will play an important role in the analyses presented later in this report. Social responsibility has been established as an outcome of science education. Social responsibility is the bridge between the science and technology community as a whole and K-12 science and technology for a general education. Many STS writers, as we will see in the next section, have already embraced this perspective.

STS and Social Responsibility

STS is one of the more recent trends in science education. And, certainly, it is one with several diverse foci, e.g., science-related social issues, technology, the history and philosophy of science and technology, traditional content presented in an STS context, etc. This section will discuss several of these in terms of social responsibility.

Many science educators (Aikenhead, 1985, 1992; Bybee, 1982, 1986; Cheek, 1992; Hurd, 1985, 1986; Penick, 1989; Yager, 1986) turned to STS because of its potential for educational relevance and utility. Hurd (1985) and others identified the rigorous study of social problems and the development of critical thinking as the preparation needed by students for the effective participation in democratic decision making as the central thrust of STS. This notion implies that science education does not have to be discipline structured and that generalizable learning outcomes are important for all students. This approach would establish relevancy as a central theme, historically a much-sought but long-unfulfilled goal of science education.

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Hurd also pointed out how this approach would allow science education to capture the essence of modern science, i.e., being socially structured as well as an influence on society. That is, contemporary science is problem centered and driven by national agendas, e.g., human genome research, supercolliders, space exploration, etc. This conception differs significantly from that portrayed by the discipline-bound, content-classified curricular materials and coursework.

The Project Synthesis (Harms and Yager, 1981) themes of personal needs, academic preparation, career awareness, and societal issues were a reaction to the discipline-based, laboratory-centered programs of the 1960s and early 1970s, as well as the essentialistic retrenchment to textbook curricula in the late 1970s. This report broadened the scope of potential curricular and instructional contexts for science education.

Project Synthesis' expression of multiple foci, probably more than any other factor, provided a coalescing impetus for the most recent STS movement. This movement resulted in an eclectic array of curricular STS programs, many of which originated within classrooms and school districts, i.e., a grassroots impetus.

For some curricular planners and science teachers, the impact of Project Synthesis broke the bondage imposed by the structure of science disciplines (Yager, 1990). Rather conservative innovators developed curriculum that continued to perceive science as a traditional but expanded body of knowledge. Thus, content-driven but socially relevant curricula and courses appeared, e.g., environmental science. Many programs of this type appeared as minicourses or electives. Other innovators sought to deliver traditional content in new, socially relevant contexts, e.g., *Chemistry in the Community* (American Chemical Society, 1988).

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Rubba (1990) indicated that the STS reform movement within science education has readily adopted a social responsibility focus. Further, he clearly identified the outcome of STS instruction as behavioral, i.e., active personal and social decision making. He stated that the goal of STS education is to help students develop the knowledge, skills, and affective qualities needed to take responsible action on the myriad of social issues facing humankind. It is evident that Rubba, using Hungerford et al.'s goals from environmental education (1980), attempted to operationalize outcomes similar to Rowe's notion of fate control. An STS-oriented science education would foster overt, responsible participation in science and technological issues. Learners would develop a sense of purpose and control about their use of science knowledge and skills in the democratic process of social change.

Rubba and Wiesenmayer's STS framework (1988) included understandings about the nature of science, technology, and their interactions, the nature of science-related issues including the role of human values, the skill to analyze and evaluate issues, the interactive social dynamics of natural or manmade events, problems, and issues, the characteristics and bases of decision making in a democratic society, and particularly the descriptive process skills and habits of the mind necessary to investigate and evaluate a science-related social issue. Rubba stated that not only should these understandings and skills be identified, operationalized, and practiced in the science classroom but also that they should be applied to real-life, community-based issues.

Hungerford and Volk (1990) stated that this combination of knowledge and experience would enhance ownership and self-efficacy, two variables among others associated with behavior change in social learning theory (Bandura, 1986; Hungerford and Volk, 1990) and that it would provide a normative, social context for behavioral change (Ajzen and Fishbein, 1977). The current popular theories in science education deal with personal constructivist approaches, i.e., a focus on object/event - individual cognition, e.g., Driver (1989). Science education has tended to de-emphasize the contributions of social psychology. Socially developed constructs (Vygosky, 1962) and the effect of social context (Ajzen and Fishbein, 1977, 1980) are probably equally or more significant if educators are committed to fostering responsible citizenship behavior. It would seem that the narrow cognitive approach concerning science education curriculum and instruction, i.e., a focus on content-only cognition, might be a result of an equally narrow perspective concerning the nature of learning for human beings.

Both Sia et al. (1986) and Hines et al. (1987) have, in fact, taken Rowe's notion of fate control a step farther. Their data indicated that variables that seem to be associated with fate control, e.g., individual locus of control, group locus of control, perceived knowledge of issue action strategies, perceived skill to use issue action strategies, were positively associated with responsible environmental behavior. In fact, Sia's predictor model accounted for almost 40% of the variance associated with responsible environmental behavior. Health educators, using related models and measuring similar variables, have frequently accounted for even more variance associated with health-related behavior (Glanz et al., 1990). The implication of this finding is that selected psychosociological variables are critical components for fostering responsible social behavior. Further, these variables are not coterminous with science knowledge but rather are representative of other knowledge constructs that are typically underrepresented in most science curricular and instructional experiences.

The idea of fostering a sense of fate control, i.e., empowerment, has led to the emergence of a new instructional/curricular paradigm for STS. The traditionally assumed relationship between science content knowledge and behavior was believed to be psychologically incomplete, cognitively restrictive, and affectively impotent in terms of fostering overt citizenship behavior. For example, Ramsey et al. (1981) reported that traditional content-only instruction did not foster overt responsible citizenship behavior. However, he did find that issues-based instruction (using the 1980 Hungerford et al. curricular framework) significantly increased responsible behavior as well as those variables that seem to be psychologically associated with such behavior. Hungerford and Volk (1990) term this type of approach the "knowledge-ownership-empowerment" paradigm. It is significant because it suggests that if social responsibility is the "end" of the science education process then there must be an appropriate "means." Further, a growing body of data indicates that instruction can be designed that fosters knowledge, ownership, and empowerment.

In appearance, the experiential components of this type of issues-based program would probably compare with what John Dewey expressed in *Experience and Education* when he called for "the acquisition of means which make direct vital appeal" and "making the most of the opportunities of present life" (1938, pp. 19-20). Tanner (1990) echoed Dewey's message in his call for contemporary problem-centered curricula that emphasized a general education as contrasted to knowledge specialization.

At a theoretical level, issues-based instruction is an attempt to combine the values and processes associated with both democracy and science by providing students with the science knowledge, skills, and opportunities to investigate, evaluate, and decide about a real, science-related social issue. At an instructional level, issues-based instruction provides a context for "authentic cognition" (Bransford et al., 1983; Brown et al., 1989), "brain-based learning" (Caine and Caine, 1991), and the use of higher-order thinking (Resnick, 1987). These writers have, in general, suggested that the narrow cognitive, affective, and behavioral dimensions of the traditional curricula and instruction have sterilized classroom experiences to an extent that student learning and affect have been numbed. In contrast, they call for authentic tasks in real-life situations, ill-defined problems and contexts, metacognitive approaches, and experiences that maximize the integration of cognition, affect, and behavior. STS issues-based instruction offers the potential for many of these curricular and instructional elements.

Another player has presented significant ideas for science education reform. The National Center for Improving Science Education (a partnership of BSCS and the NETWORK) has undertaken the development of curricular and instructional frameworks for elementary, middle school, and the secondary school science program (Bybee, 1989). Although the secondary program is still in development, both the elementary and middle school frameworks have been prepared. In both cases, the conceptual framework established parallel strands, one using a science dimension and the other a technology dimension.

At a theoretical level, issues-based instruction is an attempt to combine the values and processes associated with both democracy and science by providing students with the science knowledge, skills, and opportunities to investigate, evaluate, and decide about a real, science-related social issue. At an instructional level, issues-based instruction provides a context for "authentic cognition" and the use of higher-order thinking.

The science dimension begins with questions about the natural world, applies methods of inquiry, proposes explanations (and new questions), and culminates in both personal and social action based upon the explanations and solutions. The technology dimension begins with problems of human adaptation in the environment, applies problem solving strategies, proposes solutions to the problems, and applies the solutions in both personal and social actions. This appears to be a marriage of discipline-based (but process-driven) science with process-driven technology instruction. The innovation of this framework rests on the technology dimension and on the call for personal and social action. It is clear that social responsibility has been incorporated into the paradigm. It is not clear, however, how this framework will be operationalized. Given its process nature, it certainly must be conceptualized as more than a body of knowledge.

The National Center for Improving Science Education's model is but one discussion of technology. Fleming (1989) called for education at all levels to prepare students to make effective deci

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sions in a world of sociotechnology. He recognized the powerful mutual interactions of society and technology, as well as the social forces brought to bear in the decision making process concerning technology. His technological literacy framework identified both knowledge of technology and the development of decision making skills.

Fleming's discussion called for a technological literacy that would give rise to empowerment, a "freeing" activity. As a result, a technologically literate individual would have the power and freedom to examine and question the important issues in sociotechnology. These issues included progress in technology, appropriate technology, benefits and costs of technology, economic models involving technology, personal decisions about the use of technology, and decisions made by managers about technology. In part, Fleming argued that individuals should be able to assess the value-laden relationship between so-called factual information and the decision making process and must understand the value claims implicit in the conflicting positions. This position is strikingly similar to that taken by issues-based writers, e.g., Ramsey, 1989; Rubba, 1987a, 1990).

Like Rubba and Hungerford et al. (1990), Fleming recognized the issue as the interface of social change. For issues-based proponents, the STS issue, utilized as a context for instruction, offers the greatest potential for capturing the dynamic interplay of science, technology, and society. The implication for science educators is that instruction focusing solely on science and/or technology content restricts the knowledge bases needed by learners to effectively understand and cope with science/technology issues. And, it is the issue that most students, as citizens, will face in the real world. Traditional discipline-focused content, without its social context, is static and probably will not be empowering. Thus, like other STS writers, Fleming clearly embraced a social responsibility perspective.

The implication for science educators is that instruction focusing solely on science and/or technology content restricts the knowledge bases needed by learners to effectively understand and cope with science/technology issues. And, it is the issue that most students, as citizens, will face in the real world. Traditional discipline-focused content, without its social context, is static and probably will not be empowering.

Social responsibility is also an important agenda for another STS dimension, the HNST. A curriculum framework for the HNST instruction has been developed and published (BSCS/SSEC, 1992). The rationale of this document states:

> Students should learn about the history and nature of science and technology as well as learn the concepts and processes of these disciplines. Because science and technology are integral to many benefits and problems besetting contemporary society, students, as future citizens, must understand and be able to make decisions about science and technology. (p.186)

The HNST advocates believe that instruction about the nature of science and the nature of technology will allow students to recognize the similarities and differences, the human and social dimensions, and the limits and possibilities of these important enterprises. The following themes were presented as a basis of curriculum and instruction: (1) science is a way of explaining the world; (2) technology is a way of adapting to the world; (3) science and technology are activities that involve human values; (4) the social, cultural, and environmental contexts within which they occur influence the conduct and content of science and technology; (5) science and technology influence the social, cultural, and environmental context within which they occur; and (6) science and technology have reciprocal effects and their interrelationships vary from time to time and from place to place.

Klopfer (BSCS/SSEC, 1992) described past efforts to use the history of science as curricula, e.g., the *History of Science Cases* (Klopfer, 1964-1966) and infuse history with content, *Project Physics* (Holton et al., 1969). The current science education literature reflects a growing interest in students' developing an understanding of the nature of science. For example, Ramsey (1991) used the recent, real-world cold fusion episode as an instructional context to teach students the difference between scientific claims and scientific knowledge and how scientists work for consensus in the replication and verification process.

Hungerford et al. (1990), in approaching issues-based instruction, provided introductory instruction focused at the nature of science. In this instruction, inductive activities were used to develop an understanding of a scientific process-scientific product-technology development model. Further, historic vignettes were used to provide examples of science-society interactions. One vignette, for example, recounted the story of how

Benjamin Franklin and Anton Lavoisier were asked by the King of France to investigate Charles Mesmer's claims of "animal magnetism." Franklin and Lavoisier's strategies reflect classic experimental protocol. The episode is historically significant because that government looked to science as an arbiter of truth and knowledge, a definitive indication of the growing influence of science in the modern world (Hungerford et al., 1990).

Matthews and others (1991) also identified the importance of the interface between the philosophy of science and science education. For example, Hodson (1991) believed that science teachers are remarkably uninformed about the philosophy of science and that this condition influenced what and how they teach, often resulting in curricular confusion. Martin (1991) pointed out the distinct relationships of both science education to a moral education and a moral education to a science education.

Some issues-based instruction advocates believe that HNST content, although contextually illuminating, is awareness based. Subsequently, HNST content, on its own merits, does not offer the instructional utility compared with the potential of a real-life science/technology issue. Although HNST content lacks the authenticity critical for the development of ownership and empowerment, it does assist in enlarging and clarifying students' time-space perspective. It is, for example, important for students to understand that science and technology enterprises are as much a part of the modern landscape as the Church and feudalism were in the Middle Ages (Hetherington and Hetherington, 1992). Certainly, the Roman Catholic Church's recent vindication of Galileo offers an important message about the tension between science and religion over time. Comprehending the nature of science enables students to understand that science is but one way of knowing. These types of understandings help students connect classroom science with the real world, past to present. HNST advocates believe that students must view science as a past and present cultural activity and that this view will influence students to act responsibly as citizens in a scientific society

In summary, many STS dimensions have embraced social responsibility as a critical outcome of the educational experience. Further, some researchers have gained tentative insights into instruction that might (or might not) achieve that outcome. The implications for science education are noteworthy. Traditional science instruction has focused on academic preparation, with students mastering content knowledge in text and lecture and solving defined problems in the laboratory. Solutions were algorithmic, producing a right or wrong result. The STS perspective offers multidisciplinary instruction in the real world, with students using heuristic processes to study issues with multiple alternatives, assessing the positive and negative consequences of those alternatives, and practicing and implementing a decision making process. The STS students will be able to answer the question, "What good is science?" It provides utility in that it will assist them to make sense of the real world in a constructivist mode. It will empower them to use the values, habits, knowledge, and processes of both science and democracy to cope with both personal and societal decisions.

> **Traditional science instruction has focused on academic preparation, with students mastering content knowledge in text and lecture and solving defined problems in the laboratory. . . . The STS perspective offers multidisciplinary instruction in the real world, with students using heuristic processes to study issues with multiple alternatives, assessing the positive and negative consequences of those alternatives, and practicing and implementing a decision making process.**

Social Responsibility and Current Reform Agendas

The discussion presented above suggests that, whether the instructional means are issues based, technology based, or HNST based, social responsibility should be an end of science education. It is important to consider the extent to which current reform programs can achieve that end.

Let us consider a content-driven but socially relevant program, *Chemistry and the Community* (American Chemical Society, 1988) that used societal issues, e.g., nuclear energy, groundwater quality, etc., as its instructional organizer. The authors appeared to believe that a social issue context would provide the motivation for students to learn basic chemistry. The goal was to reformat discipline-based chemistry using a series of more relevant and interesting contexts. The program used generic issue topics, surrogate data and laboratories, and simulated decision making.

As such, the program, although topically related, still artificially separated school science from real life. Such a program implies that discipline-based knowledge, in and of itself, will foster social responsibility. Although little research about ChemCom has been published, data of other awareness-only programs found little relationship between knowledge and social responsibility (Hines et al., 1987; Ramsey et al., 1981; Ramsey & Hungerford, 1989a; Ramsey, 1991; Sia et al., 1986). These data suggest that the repackaging of science content in more user-friendly contexts might deliver the content. However, the quest for social responsibility, a more complex outcome, is another matter.

A similar analysis can be made for a middle/junior [high] school science program, *Chemical Education for Public Understanding* (CEPUP), developed by Lawrence Hall of Science. This program, funded in part by the chemical and other industries and by the National Science Foundation, seeks to provide students with experiences focused on chemicals and their interaction with people and the environment. CEPUP's rationale calls for an informed citizenship [which does] not react to chemically related issues on an emotional basis. Effective independent adulthood requires that an individual be able to process, evaluate, and use evidence and ideas to make informed decisions (CEPUP, 1992). The instruction uses an experienced-based approach with packaged kits and activities. Some of the kit titles, for example, are Risk Comparison, Determining Thresholds Limits, and Investigating Groundwater: The Fruitvale Story.

The CEPUP approach is issues-related. Like ChemCom, the primary intent is again to teach content, e.g., threshold limits, toxicity levels, concentration, etc. These concepts certainly have educational merit and utility, but, in terms of fostering decision making for social responsibility, the program developers have assumed a science content-behavior relationship. Research concerning overt, independent decision making does not support this relationship.

CEPUP is structured around surrogate data with structured activities and prescribed simulations. This format is not authentic for the students. Further, its issue focus is limited, to a great extent, to only the science component of a given issue. Students do not experience the rich complexity of differing human values that drive real issues. They do not receive the skill development experiences necessary to autonomously analyze, investigate, evaluate, and decide about issues. Nor do they apply these skills in the real world with real issues. In fact, the CEPUP program director has acknowledged that contrived instructional formats, e.g., simulations, do not foster behavioral changes (Thier, 1989). What CEPUP does effectively deliver is important introductory concepts related to some chemical issues. What CEPUP does not do is provide an instructional vehicle for social responsibility. According to Rowe (1983), the failure to examine actions, consequences, and values will lead early adolescents to their most frequently asked question, "So what?"

Now let's consider socially relevant programs that incorporate elements of action learning and/or issues-based instruction. Rubba (1987a), in reviewing the ten best school-based STS programs represented in the NSTA's Focus on Excellence series (Penick and Meinard-Pellears, 1984), characterized those programs as having two common characteristics: They involved students in hands-on investigations of STS issues and, in most cases, attempted to resolve them. Many of these programs adopted an issues focus and were structured into three broad zones. Many began with a knowledge base, moved into a skills component, and culminated in a component that applied the knowledge and skills to a real problem in a local context.

These characteristics suggest that at the practitioners' level social responsibility has been accepted as one of the dominant factors in the STS agenda. In fact, existing data (Ramsey et al., 1981; Ramsey and Hungerford, 1989a; Rubba and Wiesenmayer, 1988) indicate that programs involving these characteristics do indeed foster social responsibility. In fact, one such issues-based program (Hungerford et al., 1988) has been accepted for dissemination by the National Diffusion Network (NDN). The NDN Project Effectiveness Panel, composed of independent researchers and scientists, reviewed outcome data and accepted the program developers' claim of enhanced social responsibility as a function of issues-based instruction. That is, middle school students who received this type of instruction reported more socially responsible behaviors, i.e., the overt, independent participation in problem/issue resolution in either individual, family, or group contexts compared with both science content and control treatments. Further, parents of issues-based students provided similar corroborative data, These findings stand in contrast to curricular programs that assume a direct content knowledge-behavior link (Hines et al., 1987; Ramsey et al., 1981).

Project 2061: Science For All Americans (AAAS, 1989), in developing its new science education scope, used five criteria representing both scientific and human significance as a basis for thematic content selection: (1) utility; (2) the intrinsic value of knowledge; (3) philosophical value; (4) childhood enrichment; and (5) social responsibility. Concerning this latter criterion, Project 2061 proposed the selection of content "likely to help citizens participate intelligently in making social and political decisions on matters involving science and technology" (p.21).

Given that Project 2061 was developed by a selected cadre of scientists, this statement is remarkable. The attainment of this goal will necessitate new curricular and instructional assumptions, ones that extend beyond the "body of knowledge" view. Many science teachers believe that the best curriculum and instruction of natural phenomena involve students' investigations of those phenomena, i.e., an inquiry-based, problem solving approach. And, so it is that many issues-based educators believe that the best instructional format for social responsibility involves students' investigations of science-related, social issues, i.e., a social inquiry, problem solving approach. An integration of these two approaches counterbalances, to some extent, traditional inquiry with science policy inquiry.

The critical question becomes: How will Project 2061 authors or its curricular interpreters philosophically view curriculum and instruction? A 'body of knowledge" view simply represents a "repackaging" of traditional science content by the elimination of some science topics and the inclusion of other socially relevant topics. Evidence suggesting an answer to this question is presented in the following discussion.

One Project 2061 chapter identifies the basic habits of mind, as operationalized by the attitudes, values, and skills, that should be fostered as a result of precollege science instruction. They include many worthy components, e.g., curiosity, skepticism, calculator skills, and critical response skills. But, in terms of social responsibility the list does not include the knowledge, attitudes, and skills that most significantly predict responsible citizenship behavior, e.g., ownership and self-efficacy (Ajzen and Fishbein, 1977, 1980; Bandura, 1986; Hines et al., 1987; Hungerford and Volk, 1990; Ramsey et al., 1981; Ramsey and Hungerford, 1989a; Sia et al., 1986).

This finding suggests that Project 2061's scope is perceived by its original authors as an extended body of knowledge, one in which information about technology, mathematics, society, and the history of science has been added to existing but "thinned" traditional content. If this is the case, the means, i.e., static knowledge, do not seem to fit the end, i.e., social responsibility. Given this view, predictions of achieving effective participation in decision making appear remote.

Another national organization, the National Science Teachers Association (NSTA), has developed a new sequence for secondary school science, the *Scope, Sequence and Coordination* (SSC) program (Aldridge, 1989). This program intends to make science more accessible and understandable for all secondary students by coordinating the science disciplines in a sequenced school curriculum. Although Aldridge did maintain that science should be taught in a way that more students would be able to understand it, whether as scientists or citizens, this effort clearly represents a repackaging of the existing discipline-based content.

This reform proposal would spread out the delivery of the content, coordinate it with content from other disciplines at each grade, and instructionally move from the concrete level at the seventh grade to an abstract level at the upper secondary grades. This strategy, it is believed, will increase the pool of students in science courses, promote more effective science instruction, and produce a greater number of scientists and engineers, particularly from women and minorities. The implied goal is that science education must promote more scientists, a goal questioned by Roy (Begley, 1991).

Curricular development of SSC programs has been funded at several different sites. Although Project 2061's scope has been adopted by NSTA as the content base of the NSTA reform package, the curriculum development process will be site specific. That is, each curriculum project site will develop its own approach to sequencing the proposed scope. Therefore, each project will individually interpret and operationalize the policy handed down from the national organization. This interpretation process might lead to a variety of curricular and instructional products.

It is given that cognitive goals are important, i.e., more science knowledge is better than less science knowledge. However, NSTA has published *The Content Core: A Guide for Curriculum Designers* (1992), a document that sets forth the scope, sequence, and coordination of secondary science content. Its intent is to present science as a way of (1) learning about the behavior of the universe and the matter and energy it contains, (2) organizing this knowledge so that it is comprehensible and useful to humans, and (3) developing models and theories about this behavior that not only correlates with past observations but also helps predict future events (NSTA, 1992). Because

SSC has adopted Project 2061's scope, STS is included as an instructional theme, e.g., automobile travel, environmental quality. Here again, traditional science content is the only focus. For example, it is suggested that ocean pollution be studied by students examining biological organisms that occupy wetlands and the ocean (p.23). The narrow SSC approach, unfortunately, represents another repackaging of discipline-centered content at the expense of other knowledge bases and experiences needed by students to actualize general education outcomes. Instructional practice devoid of authentic context trivializes science understandings. Thus, more knowledge is sometimes not better than less knowledge.

The organizational source of the science education reform must also be examined. The American Chemical Society, AAAS, and NSTA are all national organizations. This factor implies budgets, staffs, organizational images and cultures, funding sources, etc. They are, in fact, stake holders with a vested interest in the reform process. Reform is an opportunity for increased institutional status.

The current reform has been mandated and driven by national organizations. This "top-down" process tends to disenfranchise those ideas, programs, teachers, and curriculum planners who, to some extent, have successfully designed and implemented their own vision of reform.

Hart and Robottom (1990) called for inputs into the reform process from all levels of science education. It would appear that such a dialogue is appropriate. National platforms, grant funding, and policy making do not, in and of themselves, win the hearts and minds of science educators. Sachse (1989) pointed out that national and state organizations should allow and encourage local efforts to reform science teaching.

Diversification of the players and dialogue among levels is critical to the effectiveness of reform. The existing reform product, a cognitive-only perspective in terms of goals and outcomes, is too narrow. Science instruction should produce students who like science, want to take more science courses, and believe that science is important. Science instruction should produce students who independently read more science, participate more frequently in science-related avocations, participate in extracurricular science activities, and actively consider science-related careers. These are legitimate and measurable outcomes.

From a social responsibility perspective, science education should produce students who can and do participate in the investigation and resolution of science-related social issues. This implies that students are willing and able (as well as believe that they are able) to effectively act as citizens using the values and skills associated with both science and democracy.

From a social responsibility perspective, science education should produce students who can and do participate in the investigation and resolution of science-related social issues. This implies that students are willing and able (as well as believe that they are able) to effectively act as citizens using the values and skills associated with both science and democracy. These, too, are legitimate and measurable outcomes. Only the STS movement has legitimately acknowledged this dimension. And, within the STS movement only the issues-based instruction advocates clearly focused on social responsibility as the ultimate outcome. A social responsibility focus enables science education to more completely embrace a general education, thus more effectively attempting to meet the present and future needs of learners and of society. Scientists and their representative organizations filter and view science education through their own eyes. These perceptions often do not represent a holistic perspective.

The possible outcomes described above suggest that greater balance between cognitive, affective, and behavioral goals must be achieved both within a student-science perspective and within a student-society perspective. Cognitive goals and outcomes have historically dominated science education and directly relate to subject-based curricula and instruction. The reform process must reconsider the basic assumptions of a precollege science education, including its educational philosophies and goals. Failure to do so will result in educators simply modifying the body of knowledge currently being delivered.

What Should the Outcomes of Issues-Based Instruction Be?

Harms and Kahl (1981) maintain that science education should produce "informed citizens prepared to deal effectively with science-related social issues." They also assert that science must develop in students a sense of responsibility, an appreciation of the potential of science to alleviate societal problems, and a sense of custodianship to protect the natural world.

Thus, instruction dealing with science-related social issues is an appropriate curricular approach for examining the interactions of science, technology, and society. Given our culture's predisposition for citizenship education and the ideas of Harms and Kahl, it can be inferred that the ultimate instructional objective is for students to become effective citizens in the world community and to be able to contribute to the solution of science-related social issues. If this inference is correct, there is a plethora of prerequisites that must be attended to before that citizenship component is in hand.

Among these prerequisites would be: (1) the ability to identify science-related social issues; (2) the ability to analyze issues and identify the "players", i.e., the individuals and/or groups involved in issues, as well as their beliefs and values; (3) the ability to use scientific problem solving skills to investigate these issues to identify the facts surrounding them and their social, economic, political, legal, and ecological ramifications; (4) the ability to evaluate the issues and determine the most effective means of resolving them; (5) the ability to use a decision making model to develop an "action plan" that can be implemented to resolve or help resolve the issues; and (6) the ability to execute the action plan if it is consistent with the student's personal values (Ramsey, 1989).

These are not instructional outcomes familiar to most science teachers. However, they are extremely important if STS education is to include social responsibility in its agenda.

Goals of STS Issue-Based Instruction

How can STS instruction best foster social responsibility? What should STS methodology and instruction include? Such questions were addressed in the development of an STS curricular framework focused at social responsibility. This framework, Instructional Goals for Issue Instruction (Rubba and Wiesenmayer, 1988; Ramsey and Hungerford, 1989b), was designed to provide students with the knowledge and skills needed to investigate and remediate science-related social issues within the local community. This framework was adapted from a similar environmental education curricular framework (Hungerford et al., 1980). The rationale is straightforward: If the goal is social responsibility, STS education must guide learners in the development of knowledge, skills, and affective qualities needed to make decisions and take action on STS issues in a responsible manner, both now and in the future. What are these goals? What do they demand of the teacher? What follows is a listing of these goals and a brief description of each adapted from Ramsey (1989) and Rubba and Wiesenmayer (1988).

Instructional Goals for STS Issue-Based Instruction

Goal 1. The STS Foundations Level.

This goal level seeks to provide learners with the prerequisite knowledge regarding (1) concepts in the natural sciences and social sciences, (2) the nature of science and technology, and (3) characteristic interactions among science, technology, and society. This level would foster the conceptual foundation needed to make informed decisions about STS issues.

Goal 2. The Issue Awareness Level.

This level seeks to provide learners with the conceptual knowledge associated with discrete issues. It also involves an understanding of the "anatomy of issues," including what separates problems and issues as well as the various beliefs and values held by societal members that impinge on the origin and resolution of issues. It would promote an understanding of the economic, religious, political, scientific, and other factors involved in STS issues. This goal also involves students' understanding the need for them to become involved in issue investigation, evaluation, and resolution.

Goal Level 3. The Investigation and Evaluation Level: Training and Application.

This level seeks to provide learners with the knowledge and skills necessary to permit them to investigate/analyze issues and evaluate alternative solutions for resolving these issues. It also involves some form of student involvement in the investigative process, including data collection, interpretation, and communication using both primary and secondary data.

Goal Level 4. The Citizenship Responsibility Level: Training and Application.

This level seeks to provide learners with the skills necessary for making responsible decisions concerning the resolution of science-related social issues. Likewise, it provides learners with an opportunity to prepare and evaluate "action plans" for issue resolution. It supports the application of citizenship action strategies if and when students are motivated to apply their action plans.[1]

[[1]The goal 4 level does not require students to take action on issues. It provides an opportunity for them to do so if they so desire it. It is unethical for a teacher to demand that students take action on an issue when said action might run counter to the student's beliefs and values.]

These goals are hierarchical, i.e., they function as a continuum in a linear manner with foundations preceding awareness, etc. Collectively, these goals encompass the knowledge, skills, and opportunities for application needed by students to understand, investigate, analyze, and evaluate issues and their solutions as well as to develop the citizenship skills necessary to help redress these same issues. Thus, STS issues-based instruction begins with a knowledge base, leads into skill instruction, and culminates in the application of knowledge and skills in a real-life STS issue. The open-ended nature of the application phase establishes a "practice effect," one in which students operationalize and construct their own issue reality. Issue-based instruction does not promote or indoctrinate a particular social, technological, environmental, or political agenda. The only view of the future . . . the only "givens" are . . . the process of democratic decision making and scientific habits of the mind. Students are provided with the enabling tools to make sense out of and voluntarily act on a real issue of their choice within the context of a science classroom.

Some science educators would claim that most students, despite an intensive conceptual and skill instruction and a personal investigation of an STS issue, would not have the necessary prerequisites, e.g., maturity, data, etc., to make an informed decision. This assertion denies the changing nature of issues as well as the current status of scientific literacy in our population. STS issues imply pending social change with a variety of resultant short- and long-term implications. Social change often occurs without scientific consensus. Further, many might argue that politicians, military, and business leaders themselves often do not have the knowledge and skills to make informed STS decisions. This condition does not seem to impede the forces of social change.

The issue instruction framework - its justifications and methodologies - will be examined in detail. But, first let us examine some of the instructional activities and products that result from this curricular approach. The . . . vignettes [on the adjoining page] provide examples of what students accomplished who were trained to investigate and act on community-based science-related social issues.

Several curricular characteristics of the issue instruction program may be inferred from the vignettes described above. These characteristics include an emphasis on interdisciplinary knowledge and skill training, a science-related issue focus in a context of the local community, scientific problem solving, personal decision making, and a balance of cognitive, affective, and behavioral goals. Further, the vignettes reflect Beane's (1990) three themes for middle-level education: democracy, dignity, and diversity. All of the vignettes above described environmental issues, although issues-based instruction is certainly not limited solely to that type. Many science students and teachers are interested in environmental issues and problems. Issues-based instruction provides a context for science and environmental education to merge, thus achieving additional curricular goals (Disinger, 1986).

What Are Science-Related Social Issues?

A science-related social issue is an issue that has its roots in science and/or technology and involves a problem surrounding which there are different beliefs and values.

A science-related social issue is an issue that has its roots in science and/or technology and involves a problem surrounding which there are different beliefs and values. Therefore, issues such as those involving genetic engineering, the use of animals in scientific research, nuclear waste disposal, groundwater contamination, human population, solid waste management, endangered plants and animals, deforestation, "pseudoscience", e.g., astrology, medical psychological quackery, etc., and "appropriate technology", e.g., the validity of lie detectors or lap vs. over-the-shoulder rear seat belts, would fit this definition, as would a host of others. The issues listed probably could best be described as general "issue clusters." For example, an array of specific issues is contained under the umbrella of "endangered plants and animals."

Vignette 1.

An Illinois community was engaged in deciding what combination of recreational, agricultural, commercial, industrial, and habitat usage was appropriate for a section of state-owned land adjacent to a local river. A team of middle school students assessed community residents' beliefs concerning the issue, as well as studied the geological and ecological aspects of the locale. Then, using the study's findings, they developed a "master plan" for the use and development of that public land. The plan was then submitted and defended at a public hearing sponsored by the state Department of Conservation. Among the farmers, boaters, bird watchers, businessmen, and others who spoke at the hearing, the students were the only participants who presented a proposal founded on data-based decision making.

Vignette 2.

The Wisconsin Department of Natural Resources (WDNR) proposed the reintroduction of the timber wolf in several northern Wisconsin counties. The issue became controversial throughout that region. A class of [midstate] fifth graders investigated the issue by randomly selecting over 300 residents in seven contiguous counties. Hand-written cover letters and a typed opinionnaire were prepared by the students and mailed to the selected residents. More than 60% of the opinionnaires were returned. Data were compiled and a report of the findings was prepared and submitted to the WDNR as well as to regional newspapers. Some of the study's respondents sent the students stories and anecdotes about personal remembrances concerning wolves. A few of these individuals were invited to the class for presentations.

Vignette 3.

In southwestern Wisconsin, advanced biology students monitored the chemical quality and the habitat characteristics of nearby streams with declining trout populations. The students, with the assistance of their teacher, planned and organized a trout habitat rehabilitation project for the streams. Funds were solicited from local sportsmen's organizations. Placement sites were established in the stream banks, and hatch boxes were built and installed by the students with the assistance of local sportsmen. Fertilized trout ova were then obtained from the Department of Natural Resources and stocked in the hatch boxes. Data obtained a year later indicated increased trout populations in the rehabilitated streams.

Vignette 4.

Illegal dumping has become an issue in many states. In southern Illinois, a county board of commissioners had received several complaints from residents concerning illegal dumping on rural roads, abandoned strip mines, and creeks. A local eighth-grade student decided to determine the extent of and the characteristics associated with the county's illegal dumping activity. The student's questionnaire along with a copy of a county map was sent to each county township road commissioner. Each commissioner reported the locations of illegal dump sites within his or her township. The student then visited each site to determine the extent of agricultural, automotive, commercial, and household wastes. A report of the findings along with photographic evidence was prepared and submitted to the county board of commissioners and published in the local newspaper. Further, the student used the investigation's data as the basis of a school science fair project.

Vignette 5.

Several states have enacted legislation mandating a refundable deposit on soft drink and beer beverage containers. A team of Illinois middle school students investigated the perceived effectiveness and acceptance of this type of legislation by sending a questionnaire to officials in those "bottle-bill" states. Given the positive nature of the findings, the students decided that adopting a bottle bill in Illinois would help reduce litter and recycle resources. They developed a strategy to lobby for the enactment of mandatory deposit legislation in Illinois. The students formed the "Middle School Bottle Coalition," consisting of eighth-grade classes in five nearby junior high schools. The students picked up roadside beverage containers, which were then washed, compacted, and sealed in one pound packages and mailed to members of the Environment Committee of the Illinois House of Representatives and other selected legislators. Funds for postage were raised by means of school bakery sales. One class of students solicited legislative support by visiting its representative at the state capital. Another class of students arranged for the representative to visit its school. The project was successful to the extent that the legislature banned containers with pull-tab tops. The students believed they were players in this result.

Three criteria govern the identification of a science-related social issue: (1) It must truly be an issue. People must, at some point, disagree concerning the status or resolution of the issue. This suggests that different beliefs and values are present. (2) The issue must be of some social significance. And, (3) the issue must be related, in some dimension, to either science or technology. That is, there must be a distinct STS interaction, i.e., science-technology, science-society, or technology-society. For example, the recent ALAR-apple issue involves the use of technology (the chemical) and its effects on society (human health). It, therefore, involves a technology-society interaction. Another example? The feasibility of the proposed Star Wars technology represents a science-technology interaction. Given that a problem/issue meets these criteria, one can assume that a science-related issue has been identified.

Why Focus on Issues-Based Instruction?

Science and technology should both be viewed as social enterprises, entities contributing to and, in turn, being influenced by societal changes. Social change typically involves positive and negative consequences, e.g., the implementation of robotic technology might increase efficiency but eliminate human jobs or an increase in recreational hunting might result in declining game populations. Therefore, the science-related social issue is the *interface of change*. The issue represents the conflict between the positive and negative consequences of the societal change process, as communicated by the beliefs and values of the issue's players.

Given a context of social responsibility, the science-related issue is the most appropriate organizer for STS instruction. It provides the greatest potential for understanding science and/or technological information in a context of its political, economic, social, and ethical implications.

Given a context of social responsibility, the science-related issue is the most appropriate organizer for STS instruction. It provides the greatest potential for understanding science and/or technological information in a context of its political, economic, social, and ethical implications. Further, STS issue instruction provides students with a plethora of opportunities for information processing, problem solving, and decision making, all of which are skills critical in a general education. It enables learners to foster a sense of ownership and self-efficacy concerning their motivation and capability to participate in democratic decision making, i.e., a coping effect.

Should science-related social issues be used as an organizer for all science curricula and instruction? Probably not. A monolithic issues approach for the various theme, e.g., science as a body of knowledge, might not provide the most effective instructional mechanism. There is, however, little doubt that science-related social issues are an effective vehicle for STS instruction. A more important question deals with the extent of STS instruction within the science curriculum. The issue instruction curriculum used to train the students in vignettes 1, 4, and 5 represented one semester of a four-semester science sequence for junior high students. The first semester of this curricular sequence was devoted to laboratory-based, science process skills and culminated in an independent physical or biological science investigation. The second and third semesters were focused at developing biological and physical science concepts inductively. The fourth semester dealt with STS issue instruction. Considered collectively, this science curriculum balanced a number of different instructional goals. Issues-based STS instruction can be infused into any precollege science curriculum, supplementing and extending a traditional science format. Or, it can be inserted, standing alone as part of a cohesive curricular package.

Why Emphasize a Skills Approach?

Some educators might be concerned that STS issue instruction is temporal and/ or lacks substance. These concerns are unfounded. If instruction were to deal with understanding specific STS issues, it would be temporal. Issues will and do change. However, instruction that develops skills, e.g., problem identification, issue analysis and evaluation, information processing, problem solving, and decision making, is generalizable. That is, the STS issue is a vehicle for the student to learn and apply skills. These skills provide students with utility because they can be applied to other science-related social issues as well as other social issues. These skills will enable the students to be more effective consumers of science and technology and decision makers about science and technology.

A skills approach also provides considerable potential for the use of higher-order thinking processes, e.g., analysis, evaluation, and synthesis of ill-defined problems. Much of traditional science instruction focuses on recall and comprehension.

The skills of problem identification, issue analysis and evaluation, scientific problem solving, e.g., inferring, hypothesizing, research design, data interpretation, etc., and decision making demand that students use an array of abstract thinking skills. Although skills are the focus of instruction, the importance of scientific knowledge is not de-emphasized. Scientific knowledge is, however, obtained and used on a "need-to-know" basis and related to the issue under investigation.

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Another aspect of the skills approach is important. Issues-based instruction is essentially an inductive curricular and instructional strategy. As such, it provides students with the skills, support, and context to inductively "construct" their own conceptualization of an issue or issues. However, unlike laboratory experiences focused solely on personal construction, i.e., object/event-student concept formation, this approach also capitalizes on social construction as students gain understandings from their formal interviews, informal conversations, and formal but descriptive data collection from issue players in the community.

The issues-based approach also includes strategies to enable students to cognitively process the complex, incomplete, and often conflicting issue data available. One of these strategies, the metacognitive "issues analysis" method, has been described in the literature (Ramsey et al., 1990). Students are enabled to make sense of an issue on their own terms. This type of educational experience offers the potential for generalized learning outcomes for most students. Brooks (1990) and many others have noted the need for learning by constructivist tenets.

Why Use the Local Community for Issues-Based Instruction?

Issues-based instruction can be enhanced when the local community is utilized. When science-related social issues are investigated in the local community or region, learning is perceived by students as real, relevant, tangible, and interesting. This approach creates a sense of "hands-on" immediacy. Such science instruction is not abstract, clinical, or apart from life. Rather, it connects science with real life. As such, the science-related social issue is a context for authentic learning.

Issues are operationalized for students as they collect data on the issue-related conditions, beliefs, and practices from the local community/region and its members. The investigation process usually demands that students invest a considerable amount of time, energy, and skill over an extended period of time. Because of this investment, the student begins to "identify" with the issue. That is, the issue becomes personal and important for the student. In fact, the students' attitudes about the issues are often clarified. This process often results in a sense of "ownership" on the part of the student concerning the issue investigated. Watts (1991) also identified ownership as an important outcome of problem solving. Ownership is a function of students directly applying problem solving strategies in the local community.

The justification presented above does not preclude the use of world, national, or regional issues as a focus of students' investigation. The larger the context, the more difficult it is to implement the investigation and decision making components. These problems can be circumvented by identifying those localized issues that are a part of and reflective of a larger issue arena.

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Summary

Science education is in a period of reform. Science instruction and curricula have historically been dominated by discipline-based content. Analyses of many programs of the current reform indicate that this condition is unchanged. All science students, however, will become citizens. All will be consumers of the products and services of science and

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technology. All will assume and be responsible for the benefits and risks of scientific and technological knowledge, products, systems, and services. All will be decision makers concerning matters of science and technology, either willfully via participation in democratic decision making or apathetically via the lack of such participation.

Science and technology shape our modern culture, impact on our individual and collective lives, and provide both theoretical visions and tangible options to improve human conditions. To be relevant, science education must provide a context for general education goals. The general education dimension provides a basis for meaningful, generalizable learning outcomes, ones providing utility for the student as a citizen.

Thus, science education must operationalize science in the social milieu. It must recognize that it is a socially driven enterprise and part of an educational system with a larger, democratic mission. STS is the only reform dimension that has recognized the potential and validity of these bases in the 1990s. And, within this dimension STS issues-based instruction has attempted to construct an appropriate means to achieve the much-sought end of social responsibility.

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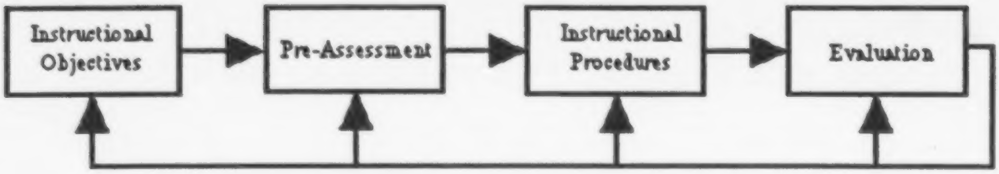
The General Teaching Model (GTM)



Harold R. Hungerford

The General Teaching Model is important to this book of readings because it serves as a heuristic device which can help instructional planners develop valid instruction for both formal and nonformal learners of all ages, K - adult. It is included here in order to help those people in the field of EE who want to prepare valid instructional materials. It provides the developer with a superior template from which to work. The GTM has proven valuable to curriculum developers and workshop leaders for over two decades. Its many attributes are explained in much more detail in the Preface and in the remainder of the document that follows.

A Preface and Acknowledgments

The General Teaching Model (GTM) was originally the brain child of Roger Robinson and David Miles of SIUC It was developed as a model for improving instructional practice at all levels. It has proven its mettle without a doubt and gained national and even international acclaim. Most recently it has achieved acclaim in medical education, particularly in problem-based medical education.

In 1996 Roger Robinson, recently of the School of Medicine at Southern Illinois University at Carbondale (SIUC) and originally of SIUC's College of Education, bequeathed me the task of continuing the work with the General Teaching Model (GTM). I do so in part because of my more than substantial respect for Roger Robinson and because the GTM simply must not pass into oblivion. As best I can determine, David Miles is no longer associated with the model.

One might wonder why it does not, now, enjoy the same acclaim as some of the other instructional models, e.g., group investigation, cooperative learning, advance organizer, the learning cycle, mastery learning, and others. The reasons are several: (1) the developers did not seek to gain the visibility needed to thrust them into the limelight of instructional modeling; (2) David Miles left SIU to pursue other interests and Roger Robinson went to SIUC's College of Medicine where the GTM is used successfully in medical education; (3) there still exists a large audience in education which erroneously believes that performance objectives (i.e., objectives stated in behavioral terms) restrict creativity and result in limiting educational goals; and (4) we still have a large clientele in education - both formal and nonformal - which fails to recognize the need for discipline in instructional planning and, therefore, succumbs to the never ending myth that anyone can develop curriculum and successfully practice instruction intuitively.

Educational failure heaped upon educational failure seemingly fails to send the message that, before an educator can successfully engage in instructional planning, enormous amounts of discipline must be applied to the process. The General Teaching Model not only advocates this discipline, it also shows the educator how to apply it in a step by step manner.

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Once it has become a skilled part of the educator's repertoire, the GTM can help take the student from simple knowledge acquisition and conceptualization to the higher order thinking skills so highly desired today in education. This correctly infers that the General Teaching Model is not restrictive at all but, instead, allows the learner to experience consistency between goals, objectives, instruction and evaluation. In many formal and nonformal situations this would be a remarkable and wonderful change.

. . . we still have a large clientele in education - both formal and nonformal - which fails to recognize the need for discipline in instructional planning and, therefore, succumbs to the never ending myth that anyone can develop curriculum and successfully practice instruction intuitively.

One needs to remember, throughout, that a large percent of what is read in this reading comes from the pens of Miles and Robinson. My contributions are nominal but result from over two decades of applying the GTM to a number of publications. Any modifications recommended by me here result from these experiences and in no way compromise the validity of this exceedingly important instructional model.

And, finally, my heartfelt thanks to Roger Robinson who willingly spent a good part of his retirement going over this revision and to Bill Bluhm who, once again, managed to show me how to improve this reading. This document is substantially better because of their suggestions and corrections!

Harold Hungerford
January 15, 1997

Introduction

The General Teaching Model (GTM) is a procedural guide for the design, implementation, evaluation, and improvement of instruction. The Model is considered applicable to all levels of education, e.g., formal/nonformal, elementary, secondary, higher, professional; all subject matters, e.g., English, science, art, social studies, environmental education; and any length of instructional unit, e.g., one hour, one week, one semester.

The major premise underlying the Model is that the goal of teaching is to maximize the efficiency with which students achieve specified objectives. The three theorists who have contributed most to the specific Model presented in this document are Robert Gagne, Robert Glaser, and James Popham.

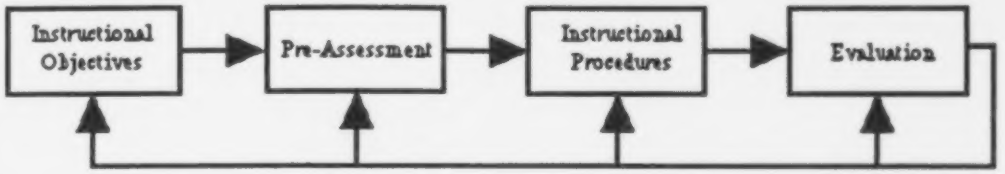
The two major functions of the Model are (l) to guide instructional designers and teachers through the major steps in designing and carrying out instruction, and (2) to provide an overall structure with which to view and study the teaching process. It should also be pointed out that many "good" teachers will find considerable similarity between the Model and the procedures they employ in teaching. Thus, the Model might well be described as an attempt to make explicit what makes an effective teacher effective.

The GTM should be of most benefit for the beginning teacher; however, experienced teachers may also improve their instruction through use of the Model. It is also hoped that the Model will contribute to the improvement of teacher training by providing the experienced and inexperienced teacher with a common frame of reference for analyzing and communicating about instruction .

Before introducing the Model, one other point should be stressed. The General Teaching Model does not propose to tell teachers what they should teach or what specific instructional methods they should employ. The General Teaching Model presents a guide for the teachers to use in deciding (l) what they would like their students to learn, (2) what instructional methods they should employ, and (3) how to determine whether their students learned what they intended. The range of possible objectives from which a teacher can select is limitless. There are dozens of different methods of teaching, and each teacher generally employs each method somewhat differently. A wide variety of equally valid means of evaluation also exists. Individual teachers must make decisions regarding objectives, instructional procedures, and evaluation on the basis of several factors such as (l) their own personal views of what is important for their students to learn, (2) the community and institution in which they teach, (3) the type of students they have, and (4) their preferences and capabilities regarding instructional methods and resources.

The major premise underlying the Model is that the goal of teaching is to maximize the efficiency with which students achieve specified objectives.

On the following page is a flow diagram of the basic design of the General Teaching Model with a brief summary of each component.



1. **Instructional Objectives.** Instructional objectives are first identified and selected on the basis of an analysis of desired learning outcomes, and then stated in performance terms.

2. **Pre-Assessment.** Prior to beginning instruction, learners are pre-assessed to determine whether they possess the prerequisite knowledge and skills to begin instruction, or whether they have already mastered some of the instructional objectives.

3. **Instructional Procedures.** Instructional activities are designed to help learners efficiently achieve the objectives. Instructional principles, such as motivation, practice, graduated sequence, feedback, etc., plus an analysis of the effectiveness with which the instructor employs various instructional methods, e.g., lecture, discussion, inquiry, independent research, are employed in the design and implementation of instruction.

4. **Evaluation.** Instruction is evaluated for efficiency in getting as many students as possible to attain as many objectives as possible. Based on the results of an evaluation, modifications can be made in the objectives, pre-assessment, and/or instructional procedures.

The major purpose of this document is to provide an overview of the General Teaching Model. Upon completing it, it is hoped that readers who are involved in instruction and presently do not use the GTM or a similar instructional model will be sufficiently impressed with the potential value of the GTM to:

1. seek out and engage in learning activities for the purpose of becoming proficient in using the GTM.

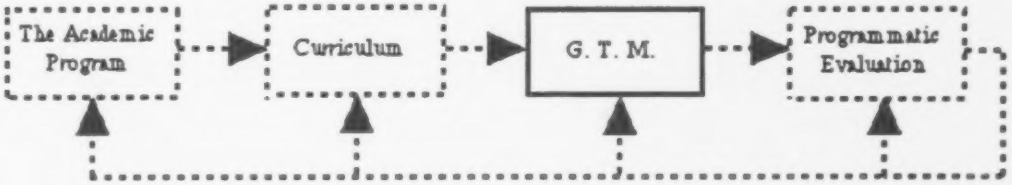
2. employ the GTM in the design and implementation of instruction.

3. recommend the use of the GTM to others who are concerned with instruction.

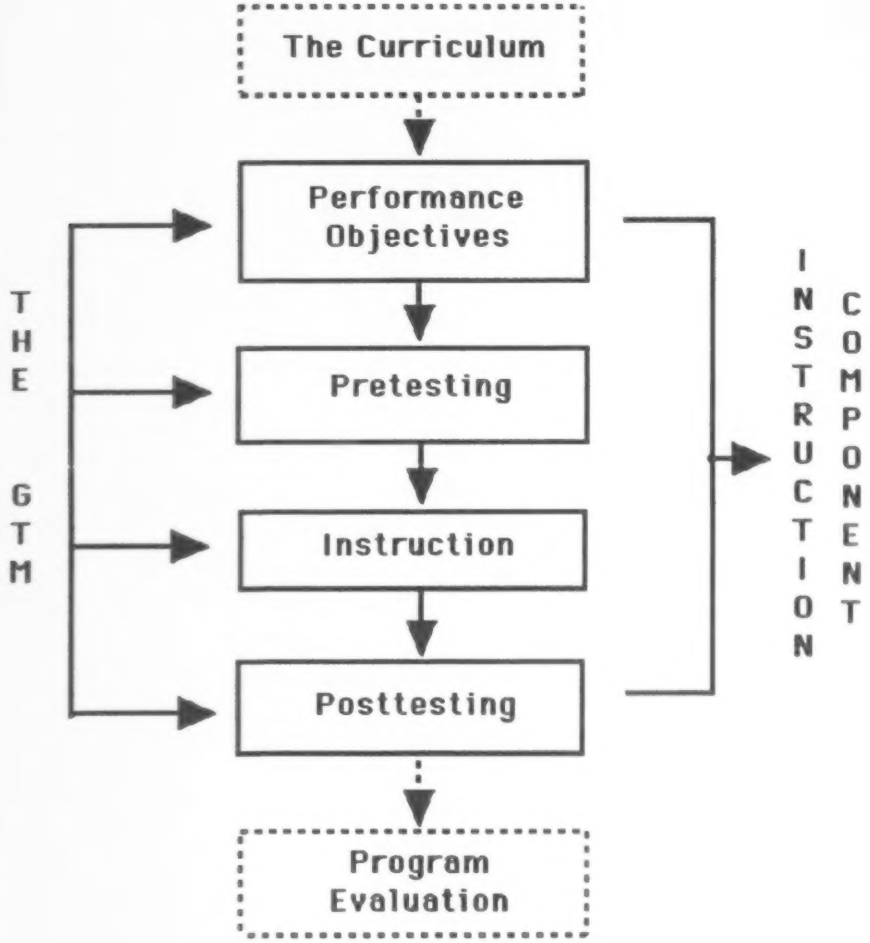
To use the GTM effectively, considerable knowledge and skill in performing the functions in each component of the Model are required. As mentioned previously, many teachers already possess much of this knowledge and many of the skills and will need only to restructure some of their procedures to successfully apply the GTM.

A Context With Which to Work

Before looking at the discrete components of the GTM, we should probably view the model in a context that may help make sense of its role in the educational enterprise. I have diagrammed such a context below which illustrates the relationships that exist between the GTM and the overall academic program (which includes the programmatic educational goals), the curricula developed for meeting those goals, and evaluation of the overall academic program. Please note the interrelationships that exist between all of the components.

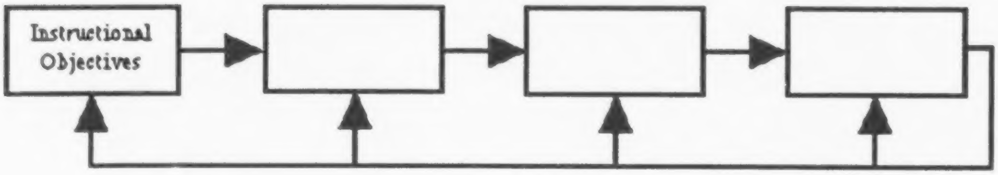


The Relationship of the GTM to Both Curriculum and Program Evaluation



An Analysis of the GTM's Components

Instructional Objectives



Instructional Objectives

The selection, and specification, of instructional objectives, i.e., known in this document by a variety of names including "performance objectives," "behavioral objectives," and "learner objectives," is probably the most important step in the GTM. This is where the instructor decides what he/she wants to teach. The two major factors involved in preparing objectives are briefly discussed below.

Decisions regarding the selection of appropriate objectives are usually based on the following factors: (l) what the students should be able to do in instructional units which follow the unit presently being taught, and after completing their education, (2) what the students are able to do prior to beginning the unit, and (3) the available instructional resources including the instructor's capabilities with the subject matter.

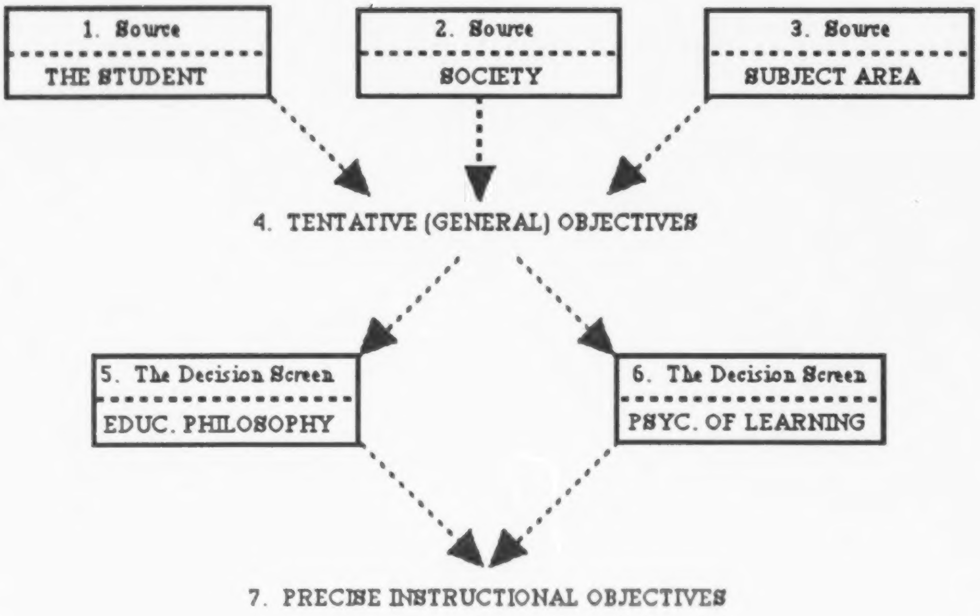
Selection: Decisions regarding the selection of appropriate objectives are usually based on the following factors: (l) what the students should be able to do in instructional units which follow the unit presently being taught, and after completing their education, (2) what the students are able to do prior to beginning the unit, and (3) the available instructional resources including the instructor's capabilities with the subject matter. When possible, objectives should also reflect those selected by the learners themselves - ones that are appropriate and reflect the learners' needs and interests.

Deciding what students should be able to do after completing their schooling or completing a course which is not designed to prepare students for subsequent courses is essentially a value decision. Whether a student "ought" to learn a foreign language or how to solve differential equations must be decided on the basis of what someone or some group thinks students "ought" to be able to do after completing school. On the other hand, decisions regarding (l) what students should be able to do in subsequent courses, (2) what knowledge, skills, and attitudes they should have at the start of a course, and (3) what instructional capabilities are available to teach them, can be based on evidence, hopefully available at hand. Using this approach, three questions can be asked about each objective considered:

1. Why should students achieve the objective?
2. Do students have the prerequisites to achieve the objective?
3. Is instruction available that will permit students to achieve the objective?

On the following page is another approach to selecting objectives. This approach is known as The Tyler Rationale and it provides a great deal of guidance in identifying sound instructional objectives.

The Tyler Rationale



No. 1 Source: What are the students' needs and interests?

No. 2 Source: What does society want people to be like?

No. 3 Source: What do subject matter experts think people should be like?

4. After consulting the above three sources, tentative general objectives should be specified.

No. 5 Screen: Does the objective agree with your philosophy of education?

No. 6 Screen: Does the objective agree with what is known about the psychology of learning?

7. The resulting objectives should be specified in precise terms. These terms should reflect observable performance/ behavior.

Another valuable technique which can be employed along with the previous procedures for selecting objectives is the use of a classification system. By writing or selecting objectives according to some classification system, it is possible to (l) select objectives which are the type or level actually desired and (2) avoid selecting an undue number of objectives of a particular type or level for a unit of instruction. Incidentally, the classification of objectives can also facilitate the planning of instruction and the communication about instruction among people involved in the instructional enterprise.

Probably the most popular classification scheme for educational objectives is that developed by Benjamin Bloom and others (1956). According to this taxonomic system, objectives can first be classified into one of the three following domains of behavior:

1. ***Affective objective:*** An objective dealing with emotions or feelings indicated by words such as interest, appreciation, enthusiasm, motivation, and attitudes.

2. ***Cognitive objective:*** An objective which deals with the thought processes (knowledge, intellectual skills such as analysis, problem solving, evaluation) rather than with the affective or psychomotor behaviors.

3. ***Psychomotor objective:*** A statement specifying performance involving physical movement, i.e., physically acting on some part of the environment.

Actually, most objectives do not belong exclusively to only one of these domains. There is commonly some element of each in all objectives. However, it is usually possible to determine whether the predominant characteristic of an objective is affective, cognitive, or psychomotor. Most objectives for elementary, secondary, and higher education fall into the cognitive domain and several sub-classification systems for this cognitive domain have been developed. One of the most commonly used systems is Bloom's *Taxonomy*, which includes the following major subcategories: (1) knowledge, (2) comprehension, (3) application, (4) analysis, (5) synthesis, and (6) evaluation.

Bloom's *Taxonomy* . . . includes the following major subcategories: (1) knowledge, (2) comprehension, (3) application, (4) analysis, (5) synthesis, and (6) evaluation.

Another important factor to consider in selecting objectives is the distinction between "terminal" and "en route" objectives. **Terminal objectives** refer to what a student should be able to do at the end of some unit or series of instructional units which is not followed by further instruction. **En route objectives** refer to what a student should be able to do at the end of some unit of instruction which will permit him to proceed to a subsequent unit. With terminal objectives the justification or rationale for the objectives is usually based on what the person is to do in the "real" (nonacademic) world. The rationale for en-route objectives is based on the performance expected of students in the units or courses to follow.

In an environmental education course the teacher may have as one of his/her *terminal* objectives the following:

> *Terminal Objective:* When the student encounters an article in the popular media dealing with earth processes as related to some social issue, he/she can critically analyze the article by identifying errors in logic, scientific facts, inferences, and/or predictions. She/he will offer alternatives to the errors detected and provide justification for the changes.

One of the many en route objectives to reach this terminal goal may be:

> *En Route Objective:* The student will be able to read an article dealing with earth processes as related to some social issue and identify (or infer) who the important players are as well as their beliefs, positions, and values related to that issue.

The rationale for the en route objective is its usefulness in achieving the terminal goal. It is derived by an analysis of the terminal goal to determine what en route objectives are necessary for success in achieving the terminal objective. The terminal objective does not appeal to a higher *instructional* objective for its justification, it stands on its own as a goal tied to the real world, not as preparation for further instruction.

Specification: Once an instructional objective is selected, it should be specified in performance terms which describe what students are to be able to do upon completing a unit of instruction. Following are several examples of performance (behavioral) objectives:

1. Subsequent to the unit on wildlife management, the student will be able to communicate critical information that is needed before decisions can be made regarding solutions to endangered animals management issues.

2. Upon completion of Chapter VI, the student will be able to identify a given persuasive action as an emotional appeal, logical appeal, coercion, or a combination of these.

3. Having identified an environmental issue of importance to the student, he/she will be able to write one or more accurate research questions designed to investigate that issue. Subsequently, he/she will be able to design and distribute an instrument which is valid for collecting data in an effort to answer the research question(s) in an empirical manner.

En route objectives are selected by analyzing the terminal goal to determine what objectives are necessary for success in achieving the terminal objective.

4. After instruction in the use of surveys, questionnaires and opinionnaires, the student will be able to list a set of rules that should be respected when developing one of these research instruments.

5. Upon completion of the module, the student will be able to identify six governmental or private agencies to which a person can write for specific information about an environmental issue.

6. Given a common social problem (narcotics, integration, teen pregnancy, etc.), the student will be able to apply the problem solving procedure taught in class to analyze the problem and to produce three possible approaches to a solution.

7. The student will produce a collage which expresses his/her personal interpretation of a recent environmental problem or event. The collage must (l) incorporate at least three of the collage techniques presented in class, and (2) contain sufficient visual information for the majority of the class to identify the problem or event.

In contrast, non-behavioral objectives are written statements which typically describe one or more of the following:

1. Topics or material to be covered in a unit of instruction, e.g., this course will deal with historical existential movements in underground films.

2. Activities in which students will engage in a unit of instruction, e.g., students will see and discuss several films which were shown on the underground circuit.

3. What students should "learn," "know," "understand," or "appreciate" as a result of completing a unit of instruction, e.g., students will learn to appreciate the major film interpretations of existential philosophy.

Although the information provided by this kind of objective does tell something about what students may learn in a unit of instruction, the actual behavior students will be expected to exhibit to demonstrate mastery of a unit is not specified. Following are eight examples of non-behavioral objectives:

1. Students will learn to critically analyze articles which discuss environmental issues.

2. This unit will deal with the personal interpretations of individuals' values.

3. This course will cover legal and moral codes.

4. Students will gain a deep appreciation of pristine environments.

5. Students will understand the taxonomic classification system in biology.

6. At the end of this unit, students will know the problem solving procedures presented in class.

7. The art class will learn to make collages.

8. The students will learn to listen carefully in discussions.

Robert Mager suggests that behavioral (performance) objectives should contain the following three elements:

1. ***Conditions:*** A description of the class of stimuli to which the student is to respond, e.g., the type of questions, tasks, or problems, and the form in which they will be presented; and the relevant conditions under which the student will be expected to perform such as materials or equipment which will be available, environmental conditions which may affect the performance, special physical or psychological demands which may exist.

2. ***Behavior:*** A statement containing an action or behavioral verb which connotes or denotes the behavior the student is to perform, e.g., identify, write, describe, solve, classify; and a general reference to the product of the student's behavior, e.g., an essay, a diagram, a three-dimensional model.

3. ***Criteria:*** A description of the success criteria by which the student's behavior is to be judged acceptable or unacceptable, e.g., correctly applies three principles, identifies 8 out of 10; solves the problem; the idea must be different from any in the textbook, discussed in class, or produced by other students.

Performance objectives should contain the what, the how, and the how much of the expected performance. Thus, Conditions become "the what;" Behavior becomes "the how;" Criteria become "the how much."

More About Performance Objectives

Some years ago, James Popham had recommended that objectives should be written at a moderate degree of specificity - avoiding grossly general and minutely specific extremes. For example, five or six objectives for a semester course would probably be insufficient and one objective for every item on every test would result in objectives which were too specific.

Objectives should avoid very general and minutely specific extremes.

It is impossible to suggest an ideal level of specificity for each unit of subject matter, but Popham offers one useful guideline - objectives should be written so that achievement of them can be measured by more than one test item. For example, achievement of this objective - *The student will correctly add any pair of two-digit numbers* - can be measured by a large variety of test items, while achievement of this objective - *The student will correctly add 34 and 75* - can be measured by only one test item. The following is a more realistic illustration of the contrast: *The student will be able to identify the structure in any of Mark Twain's books* versus *The student will be able to identify the structure in Mark Twain's book* Tom Sawyer.

Another general guideline for specifying objectives is that the performance required by an instructional objective should match as closely as possible the post-instruction performance expected of course graduates.

Most of the emphasis in school subjects is on cognitive objectives. Currently, however, more and more attention is being paid to affective goals. For example, there are those who take the position that the most effective kind of instruction is that which gets students vitally interested in a subject. Once a student is "hooked," the learner may tend not only to learn more during the time he/she is under the instructor's influence, that same learner will be more likely to pursue the subject after completing the course. When contrasted with some courses in which the objectives require students to master enormous amounts of cognitive material but end up with learners despising the subject to such a degree that they avoid any further contact with it, there appears to be some support for attending to affective goals.

Another issue regarding instructional objectives is the matter of permitting students to participate in the selection and specification of goals. Researchers have frequently found that when students choose their own learning goals they tend to achieve the goals more rapidly than when the teacher has exclusive control over the selection of objectives they are to achieve.

Thus, some procedure whereby students can select from several alternative objectives for each unit, or where students identify general goals and with the teacher's help translate the general goals into specific objectives could have valuable motivational benefits. Generally, with this latter procedure teachers would establish certain subject matter boundaries within which students should identify their goals. An example of where this strategy is applied is in the Issue Investigation and Evaluation Model (Hungerford, et al., 1996). In this instance, the student meets a number of prerequisite objectives dealing with those skills needed for the thorough investigation and evaluation of science-related social issues. Then, with the teacher's support, the student chooses an issue of importance to him/her and *sets about to decide* on the research questions to probe, the instrument used to gain that information, the data sets to be used, and the conclusions, inferences and recommendations which logically fall from these strategies.

Another procedure is for the teacher and the students to each select a certain percentage of the objectives for the course. The teacher could then be assured that students will master the cognitive objective she/he considers essential for success in subsequent units or courses and also increase the likelihood that students would acquire more favorable attitudes toward the subject .

Although it may not be immediately apparent, the use of performance objectives may influence instruction in many ways. Some of the more important potential benefits of using performance objectives are as follows. These objectives can . . .

1. . . . facilitate instructional design and development by providing clear goals toward which to work.
2. . . . facilitate curriculum development sequencing, thus eliminating gaps and overlaps.
3. . . . promote more efficient communication between teachers, administrators, researchers, students, parents.

4. . . . make evident what students actually learn, thereby permitting selection of most important goals.

5. . . . permit instruction to be evaluated and thereby improved.

6. . . . promote individualized instruction by making possible criterion-referenced evaluation - each student can be required to master all objectives. (Independent learning is also promoted.)

7. . . . permit students to be more efficient learners, when they find out what is expected of them.

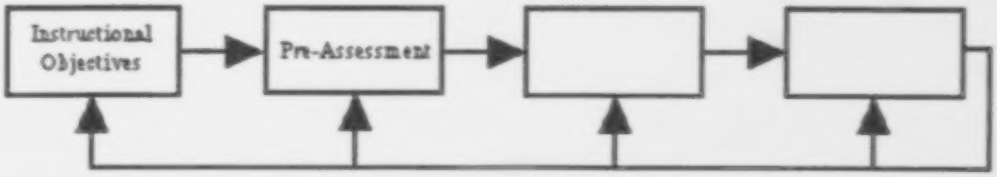
8. . . . eliminate the time wasted when students can already achieve all or some objectives before beginning a course (proficiency and advanced placement exams).

9. . . . tend to impose a philosophy of teacher responsibility for getting students to master objectives.

10. . . . promote the idea of behaviorally analyzing all components of instruction - entry behavior, intermediate behavior, and terminal behavior.

11. . . . facilitate research in education and help to advance valid instructional technology.

12. . . . promote a new role for teachers as instructional designers, managers, and resource specialists as opposed to information dispensers .



Pre-Assessment

Prior to beginning a unit of instruction, it is desirable to assess students to determine: (l) how much of what is to be learned in the unit they already know; (2) whether they have the prerequisite capabilities for the instruction to follow; and (3) the instructional activities which should be prescribed for each student. Of course, the assessment should be based on the instructional objectives specified for the unit. The results of this assessment should provide the following information:

(l) whether any students may omit any of the objectives in the unit.

(2) whether any students should be required to master prerequisite skills prior to beginning the unit.

(3) whether specific instructional activities should be presented for specific students.

As many teachers know, when whole-group-paced classes contain students with wide ranges of knowledge and skills, everyone usually suffers. The bright students can be held back, the slow students can get left behind, and the teacher may well be frustrated by trying to provide learning activities which accommodate most of the class. Traditionally, the most obvious solution to this problem was individualized instruction, and perhaps the next best strategy was some form of tracking. But in situations where neither of these alternatives exists, some other solution was needed.

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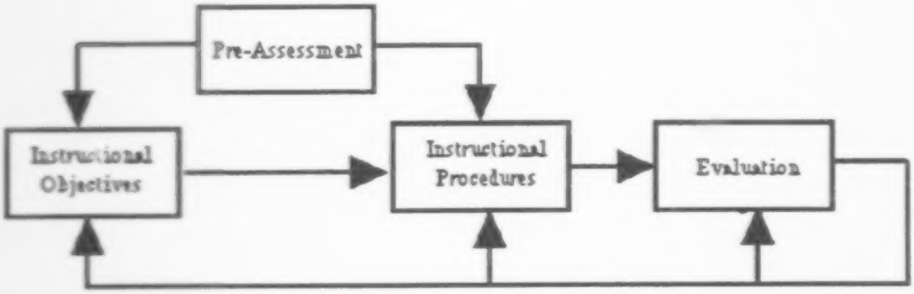
By establishing minimal performance standards for a course, the instructor has a legitimate basis for requesting that some procedure be established for students to acquire prerequisite skills. Such procedures might include prerequisite courses, or independent study programs. If, on the other hand, these procedures are not available, it seems that some form of subgrouping with different levels of objectives for different groups might be a feasible solution. This solution is, of course, most undesirable for sequential subjects such as reading and mathematics, since many students are typically "passed" to the next course or grade without having achieved the level of performance considered necessary for succeeding in the next course. These students eventually build up a cumulative deficiency which makes academic success impossible. In subjects and courses which are not sequentially dependent, i.e., where mastery of each unit is not necessary for succeeding in subsequent units, it is probably unnecessary to attempt to get all students to master the same level of achievement. Thus, specifying different performance standards for different individuals or groups is reasonable, and can be done on the basis of the students' pre-assessment performance.

In today's educational climate, a great deal of attention is given to cooperative learning. A number of North American professionals have developed models of cooperative learning which they purport to reduce a number of the problems noted above. Where cooperative learning has been implemented successfully, these problems have been ameliorated to a great extent. Most if not all students can now be expected to achieve at least a minimal set of objectives with many heretofore "difficult" prerequisite objectives now attainable by most everyone through the auspices of teachers using cooperative learning strategies.

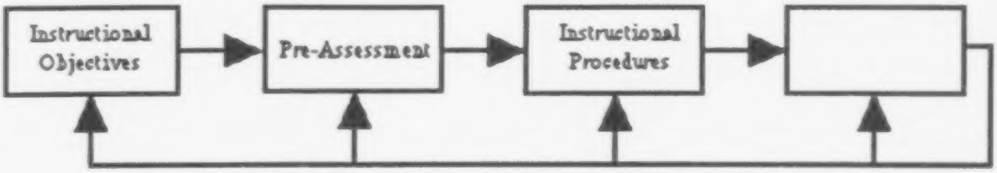
Pre-assessment is probably most essential when an instructor is beginning a unit of instruction and he/she is unfamiliar with his/her students' skills, knowledge, and attitudes regarding the material to be covered in the unit. However, in situations where instructors have the same students for a semester or a year, pre-assessment for each unit may be unnecessary. In courses which are sequential in nature, the successful completion of one unit should serve as evidence of the student's capability of entering the next unit. Thus, an extensive pre-assessment would only be necessary at the beginning of a course sequence or semester long course.

These conditions, where teachers really know their students and have them for long periods of time, bring into focus the need to adjust the GTM as necessary, in both theoretical and practical dimensions. The premise has always been held by the developers that GTM flexibility is needed in instructional planning in order to accommodate a large number of variables, some which are extremely complex and arise from a number of quarters.

One example of a modified GTM follows:



For short units or modules (one week to a month), less extensive pre-assessment would certainly be appropriate. A few items from each end-of-unit evaluation could be used. A short interview with each student, or an informal class discussion could be employed to reveal the general level of students' preparation before beginning the unit. By such informal techniques students who appear to have either considerable knowledge, or inadequate knowledge regarding the objectives to be achieved for a unit can be identified and provided with a more extensive pre-assessment to determine what specific objectives can be omitted and what specific prerequisite skills are needed.



Instructional Procedures

After students are pre-assessed and adjustments made, such as adding or eliminating objectives or requiring prerequisite learning, the instructional procedures are implemented. The design of the instructional procedures involves: (l) selecting the mode(s) of instruction which appear most efficient for getting the most students to achieve the specified objectives; (2) selection of available instructional materials, e.g., books, films, lesson plans; (3) preparing new instructional materials when necessary; and (4) developing a sequential plan which takes students from where they are at the beginning of a unit to mastery of the unit objectives.

The ten topics/generalizations specified below are, to a large extent, based upon instructional research and are examples of principles which should be consulted in designing instructional activities. It should be noted that every application of these principles will not automatically apply to all students and all subject matters. Students vary in the way they learn; subject matters vary in their structures; teachers vary in the way they interpret and apply principles of instruction. Thus, application of these principles in each situation and with each student must be continually assessed. The ten principles are discussed below.

1. **Pre-Learning Preparation.** Learners must have mastered the prerequisite behaviors for succeeding in new learning experiences. Learners also should be prepared for new learning experiences by warming up, being informed of what previously learned behaviors will be helpful or harmful, and acquiring an appropriate "set" (predisposition to respond in a particular way) for what is to follow. The use of the "advance organizer" is highly recommended for certain kinds of cognitive learning. A preview or an advance organizer at the beginning of a chapter or film can increase learning efficiency. Providing students with the instructional objectives for a unit has also been found to facilitate learning. It is seldom a wise instructional decision to use hidden agendas with students - a technique which is, unfortunately, still popular with many instructors at all levels of education.

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2. **Motivation.** Students are more efficient learners if they have a desire to learn what is being taught. This desire can be promoted by convincing learners of the value of mastering the subject matter and by making goals which they already desire, e.g., acquisition of desired information or skills, social approval, grades, etc., available to them for accomplishing learning objectives. Selecting subject matter that interests and/or permits students to participate in planning their educational activities can increase their desire to learn. The learning task should be presented in such a way that the learner feels challenged and also confident that he/she can succeed. Shaping favorable attitudes toward the subject matter, the instructor, learning, and education in general can have positive long-range consequences for student achievement.

There is little hope in taking a position that motivation is entirely a self-generated phenomena residing totally within the student. If one takes this position, it offers no possibilities for the school, the home, or the community to manipulate the environment to improve motivation. In fact, whatever position one takes, it must be conceded that it is not possible to absolutely confirm anyone's motives. Most people are probably operating under all of these motivation systems, depending upon the circumstances of the moment.

All motivational techniques should probably deal with positive or nonaversive styles. In each case there should be a positive or desired consequence following learning which motivates the student.

It may be that a major portion of a particular learner's behavior is in the form of avoidance or escape behavior. The student performs to avoid a spanking, verbal harassment, loss of privileges at home, etc. This type of motivation scheme is at times more common because it is more easily set up. We often are told what bad things will happen if we do not attend class or prepare our lesson. Detention, probation, expulsion, retention in a grade, and many other negatives are specified as consequences for non-performance. We have learned well how to tell people what they *should not do*, and the consequences. We are less sophisticated in our ability to say what a student *should do*, and the positive outcomes.

Although the evidence from research is not conclusive, learning for desirable outcomes, as perceived by the learner, may be more effective than aversive control in achieving both cognitive and affective objectives.

> **. . . learning for desirable outcomes, as perceived by the learner, may be more effective than aversive control in achieving both cognitive and affective objectives.**

3. Providing a Model of Terminal Performance. When possible, learners should be shown examples of what they are to produce or do at the end of a learning experience. Imitative learnings is one of the most effective procedures by which humans acquire new behaviors. For example, providing students with sample term papers, previously completed projects, final exam papers, or demonstrations of the desired performance can dramatically facilitate learning.

4. Active Responding. At the outset of instruction, learners can profit from watching or listening to someone else perform the acts to be learned, but most learners will become proficient only if *they* perform the acts to be learned. *Thus, it is what the learner does— not what the teacher does—which determines learning.* With verbal presentations (oral or written), interspersed questions can insure that learners are attending to, and acquiring, what is intended. In learning verbal material from a textbook, most students can profit by overtly reviewing what they have read while not looking at the material. The stimuli to which learners attend and the responses they make in the learning task should match as closely as possible the stimuli and responses in the terminal instructional objective.

5. Guidance. Learners should be given guidance and prompting when attempting to demonstrate new behaviors to be learned. Such prompts should be eliminated gradually, so the learner is able to perform the task without them. For example, verbal guidance could be given for each step in carrying out long division problems - then the verbal prompts should be eliminated gradually.

6. Practice. Opportunities should be provided for learners to repeatedly use newly learned behaviors. Since most instruction should be designed to provide knowledge and skills which are to be used sometime after completing instruction, something must be done to insure that what is learned will be retained and transferred to real life. Over-learning, which involves repeatedly using or practicing a newly learned behavior, can greatly facilitate retention. Practice and reviews which are spaced periodically after initial acquisition is also an effective procedure. If skills require performance with a variety of tasks and situations, practice should be provided with varied tasks and situations. Practice will also be more effective to the extent that the behaviors practiced are similar to behaviors to be performed in the future (the terminal objectives).

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7. Knowledge of Results. Learners should have prompt and frequent knowledge of the success of their responses. The learner must find his/her success rewarding in order for the behavior to be reinforced. Ideally, the learner should know an instant after he/she makes a response whether it is appropriate or not. When possible, the learner should be provided with the criteria to evaluate the correctness of his/her own response. When the learner is personally confident of the correctness of his/her response, external confirmation may be unnecessary, but when he/she is unsure, such feedback is generally desirable. Often, when a learner's response is incorrect, the student should be informed of the correct response.

8. Graduated Sequence. Subject matter should be organized in a hierarchical form from the simple to the complex - from the familiar to the unfamiliar. The steps should be paced so that the learner succeeds in each step, but does not become bored. One approach to sequencing instruction involves a careful analysis of each terminal behavior for which

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an objective can be stated. The same question is then asked again and again - each time specifying objectives which are prerequisite to performing objectives at the next higher stage - until eventually the instructor arrives at the behavior with which he/she expects his/her students to begin the course or unit. Thus, by working backwards, a sequence of enroute or intermediate objectives are identified which should lead a student from entry to mastery of the objective. In addition, permitting students to follow their own sequence in achieving well-defined objectives can improve upon teacher-designed learning sequences.

9. Individual Differences. People learn at different speeds; thus, critical learning experiences should often be designed in such a way that students may proceed at their own pace. Some students will require considerable practice to master a concept, while others may acquire the same concept upon their first encounter.

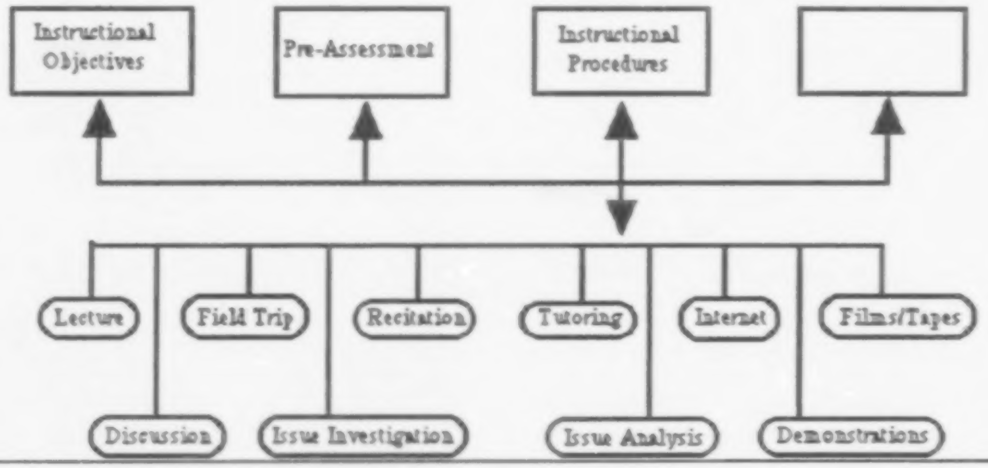
10. Teaching Performance. Skills in stimulating interest, explaining, guiding, identifying and administering reinforcers, and managing classroom behavior can make an enormous difference in instructional effectiveness. Unfortunately, such social skills are often the most difficult to learn, but some current work on the analysis of social and personality factors in teaching shows promise of reducing some of the complexity. The changing role of the teacher from information-dispenser to the manager of instructional experiences is also an encouraging development.

There are a number of distinguishable modes of instruction. Some of the following are among the most frequently used (others are losing popularity):

1. lectures
2. discussion classes
3. recitation classes
4. inquiry/problem solving (various ways)
5. tutoring sessions
6. demonstrations
7. independent study
8. programmed instruction
9. reading (books, magazines, papers, etc.)
10. films, television, TV tapes
11. computer programs/simulations/instruction
12. field trips and the use of other community resources

Each of these modes can be analyzed in terms of the extent to which each of the ten principles of instruction, described previously, can be effectively applied. The result of such an analysis can then be consulted in determining which mode or combination of modes would offer the most efficient instructional procedure for achieving particular objectives.

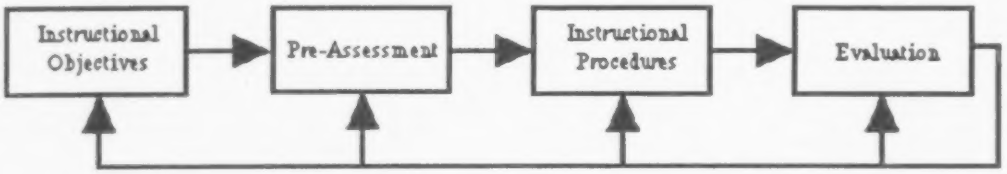
In selecting modes of instruction the instructor should take into consideration his/her own strengths and weaknesses in using each mode. For example, if an instructor is a highly stimulating speaker, it would be reasonable for him/her to give an introductory lecture to stimulate his/her student's interest (motivation) in a new unit. On the other hand, an uninspiring speaker should probably use another means to motivate his/her students - such as a film, a thought-provoking article, a field trip, a group discussion, or even a visiting speaker. Similarly, a teacher who has a tendency to dominate group discussions should either employ discussion procedures which exclude him/her from participating or avoid using discussions. The availability of alternative modes of instruction which might be employed can be depicted in the GTM as follows:



Most of the principles of instruction and the alternative modes of instruction are concerned with the achievement of cognitive goals. Unfortunately, little concrete information is available regarding the most effective procedures for achieving affective goals.

Among the few generalizations which can be made are: (l) permit students to have as much control over what and how they learn as is feasible, (2) try to select objectives and learning experiences which would be of interest to the students, (3) provide learning activities which are challenging but with which a student can succeed, (4) attempt to win the respect and affection of the students, and (5) the instructional environment should be made as pleasant and comfortable as possible (from the student's point of view), e.g., this would include concern for such obvious factors as temperature control, elimination of visual and auditory distractions, and the use of comfortable furniture.

In addition, the use of stimuli which have positive associations for the students might be introduced, e.g., popular music before class begins, inclusion of humor in instructional presentations, use of current and "relevant" examples to support a point, use of graphic and visual media in the contemporary idiom.



Evaluation

When students complete a unit of instruction, they are evaluated to determine whether the instruction was successful in helping the students achieve the unit objectives. Typically, this involves the administration of tests and instruments to measure the acquisition of knowledge, skills, and attitudes. If the objectives have been clearly specified, test preparation is simpler. Probably the most important idea in designing evaluative measures is that the test measures the behavior specified in the objectives. It is also important to note that it is the success of the instruction - and not just the success of the pupils - which is also being evaluated.

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Two general types of instructional evaluation which have been identified are (l) "criterion-referenced" evaluation, which means that each student's performance is judged according to some set standard and (2) "norm-referenced" evaluation, the system in which a student's performance is judged according to how it compares to the performance of a group or class of which he/she is a member.

Each of these types of evaluation is typically used for different purposes. The two major purposes of criterion-referenced evaluation are . . .

1. . . . to evaluate the effectiveness of instruction.

2. . . . to determine whether each student achieves the objectives in a unit.

The two major purposes of norm-referenced evaluation are . . .

1. . . . to determine how students performed in a course in comparison with each other.

2. . . . to produce academic performance data (grades, marks) for making decisions about admission to schools and special programs, retention in school, scholarships, honors programs, and how well the school is doing in meeting societal expectations, etc.

In many instances it is desirable for all students to master all objectives to some specified level of performance. Other subjects or courses which have a sequential progression also frequently require all stu-

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dents to achieve a given level at each stage to succeed in following units. In these instances a criterion-referenced evaluation system would seem to be the most appropriate procedure.

When students do not achieve the criterion for acceptable performance in a unit after having ample time to complete the unit, an explanation must be sought from among the following reasons: (l) the unsuccessful students were inadequately prepared for the unit initially which could mean that the objectives were unrealistic or that the students should not have begun the unit without prior training, and/or (2) the instruction was improperly designed or implemented, e.g., ineffective motivational procedures were employed, or insufficient time for practice was provided. Changes in the objectives, the post-instruction evaluation procedures, the instruction, or the pre-instruction evaluation should be made on the basis of the evaluation results (note the feedback loop on all of the GTM model flow charts). In addition to making changes based on observed results, modifications in these elements should also be made on the basis of new developments in materials and techniques, new research findings, and changing values.

When group-paced instruction is used, it is usually unrealistic to expect all students to master all objectives for each unit. Students learn at different rates, and at the end of a unit students will have achieved differing levels of mastery. However, the criterion referenced strategy can still be used in these instances to determine how many objectives each student achieves, and thus the effectiveness of instruction can be described in terms of the percentage of students achieving various levels of mastery.

As pointed out previously, the purposes of norm-referenced evaluation systems do not normally include determining whether students achieved specified objectives or evaluating the effectiveness of instruction. Thus, from the GTM point of view, i.e., maximizing instructional efficiency, the norm-referenced evaluation system is of lesser value. However, some kind of information regarding a student's position relative to other students in the area of academic performance appears to be needed for a variety of functions. Perhaps this kind of information should be generated in courses and subjects which do not require all students to meet a particular level of mastery - or in courses where students are permitted to go beyond a required standard.

Thus, it should be re-emphasized that, with respect to evaluation . . .

1. . . . it is the success of the instruction as well as the students which is being evaluated.

2. . . .unsuccessful instruction could well be the result of one of the following reasons:
   a. Students did not have the prerequisites necessary to begin the unit.
   b. The instructional activities were inadequately designed.
   c. The instructional activities were inadequately implemented.

3. . . .changes in objectives, pre-assessment, and instructional procedures should be made, if necessary, so that the most students achieve the most objectives possible while maintaining positive attitudes about their learning.

An Addendum To the Topics of Instruction and Evaluation: A Possible Mix of Mastery as Well as a Continuum of Success.

What we read here might suggest to some a rigid and rather cold approach to instruction. Once again, let us point out that this is not the case. Many are the times when, especially with cognitive skill objectives and, in particular, with those dealing with higher order thinking skills, some latitude in achievement will be observed and even expected. Too, one can visualize a scenario involving very closely related objectives, each critical to the other, in which learners will need to approach mastery with some and have a certain flexibility with others.

The General Teaching Model (GTM) is not a cold and rigid approach to instruction as it might seem at first glance.

An example seems to be in order. If we look closely at a current instruction design focused on teaching middle and secondary school learners how to seriously investigate and evaluate community-based science-related social issues (Hungerford, et al., 1996), we find numerous objectives which are prerequisite to the final and complex assignment of choosing an issue of interest and going out into the real world and applying those skills learned earlier.

Early in the issue investigation model, we find objectives like the following:

> . . . correctly apply the term "interaction" when writing about or discussing the environment, an environmental problem, or an environmental issue.

> . . . analyze an environmental problem and name the ways in which that problem affects both human beings and the environment.
>
> . . . analyze environmental issues and identify the players, the players' beliefs, and the values that are associated with those beliefs.
>
> . . . given a set of research questions about an environmental issue, correctly evaluate each against the rules for writing research questions.
>
> . . . read two environmental news articles and state at least two differing value positions as expressed in each article.
>
> . . . prepare a list of rules that should be respected when developing surveys, questionnaires, or opinionnaires.
>
> . . . communicate the basic rules associated with sampling populations of human beings.

Later in the issue investigation model, we find objectives like the following:

> . . . plan for and conduct a research study which focuses on the use of a survey, questionnaire, or opinionnaire. In addition, successfully communicate the data collected during that research.
>
> . . . apply all necessary action skills and knowledge in developing a plan for action concerning some environmental issue. This would include identifying and summarizing the issue, identifying and evaluating possible actions, and making a final recommendation concerning action on the issue.

The objectives found early in the model are ones which can be evaluated rather easily against obvious criteria while often giving the teacher some latitude in determining the exact "how" of the overt behavior that will be observed, e.g., in writing, orally stated, etc. Conversely, those found later in the model are often seen to reflect a good deal more latitude in terms of exactly what the research study or the action plan will look like. With these objectives, it is expected that learners will succeed along some continuum which is controlled not by the quality of instruction necessarily but by numerous other factors not easily predicted nor controlled, e.g., time needed for secondary research to be conducted, the speed with which experts will answer their mail, how willing a population is to be sampled, the complexity of the data which are gathered, and so on.

Even though one expects a good deal of variety in the appearance of the students' research products (written and/or oral), the expectations of the teacher for the students are clearly expressed in a list of criteria the teacher will use in the evaluation of the research. In this model, the use of a contract is recommended and some criteria are suggested to the teacher. These suggested criteria include:

Quality of the research questions
Techniques used in the investigation
Seriousness of approach to the research
Quality of the data collected
Accuracy of conclusions
Quality of inferences
Accuracy and organization of a written report
An evaluation of the oral presentation

All of the criteria can carry point values with are communicated to the students.

Furthermore, a master plan is given to the teacher to help provide sequential due dates to the student. These due dates would include such variables as (1) approval of the research question(s), (2) approval of data collection plan, (3) approval of instrument, (4) approval of charts, tables, and graphs, etc. In addition, these due dates are carefully communicated to the student. All of these variables can carry with them an evaluative condition. For example, to receive full credit for meeting the due dates the student must, indeed, be on time with these tasks. This is not to say that the teacher cannot afford some flexibility when some unforeseen barrier keeps a due date from being met. When working in the real world with the learners, the teacher must understand that there are a myriad of variables at play, over some of which the student has little control.

Working with young learners to help them meet these objectives is not an easy task. Trained teachers, however, find that the students love the challenge and are more than willing to meet that challenge. Additionally, more than one teacher reports that students do not want to return to the traditional program once the issue investigation is completed. Interestingly, many teachers report grades improving unexpectedly and several dozen issue investigation instructors have told the developers that achievement scores have improved as well.

Thus, all things connected with the GTM are not cast in stone nor are they black and white. The instructor remains the one professional that can give life to an instructional unit or course of study. That same instructor determines, in many cases, the degree of flexibility that is built into broadly but carefully written objectives. We should surely work to bask in the glory of many, many learners meeting rational goals and objectives in school, hopefully in preparation for a successful life in society.

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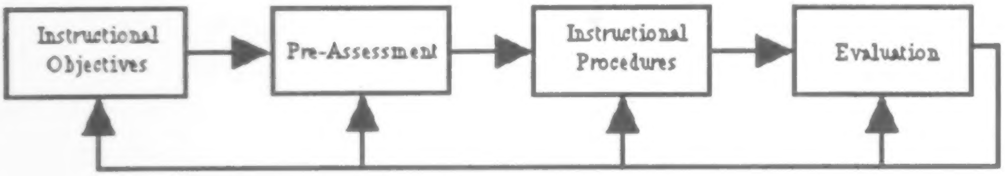
Summary and Conclusion

The purpose of this paper was to present an overview of the General Teaching Model. Hopefully, the following summary of the Model makes more sense to the reader now than it did initially!



1. **Instructional Objectives.** Instructional objectives are first identified and selected on the basis of an analysis of desired learning outcomes, and then specified in behavioral terms.

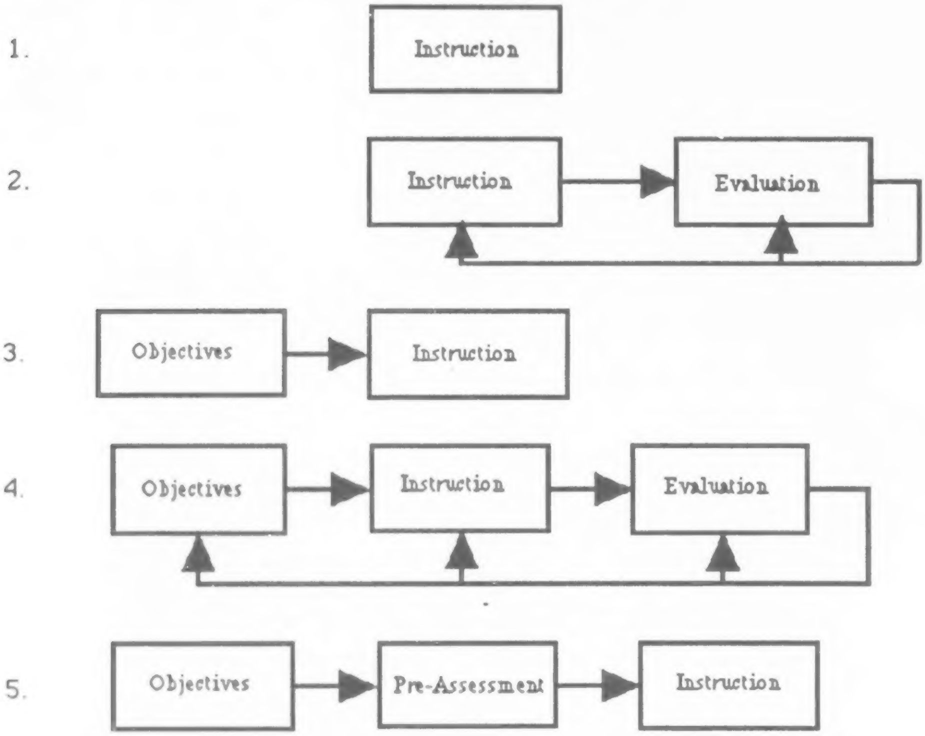
2. **Pre-Assessment.** Prior to beginning instruction, learners are pre-assessed to determine whether they possess the prerequisite knowledge and skill to begin instruction, or whether they have already mastered some of the instructional objectives.

3. **Instructional Procedures.** Instructional activities are designed to help learners efficiently achieve the specified objectives. Instructional principles, such as motivation, practice, graduated sequence, feedback, etc., plus an analysis of the effectiveness with which the instructor employs various instructional methods, e.g., lecture, discussion, inquiry, field trips, independent study, are employed in the design and implementation of instruction.

4. **Evaluation.** Instruction is evaluated for efficiency in getting as many students as possible to master as many objectives as possible. Based on the results of an evaluation, modifications are made in the objectives, pre-assessment, and/or instructional procedures.

It is also hoped that the reader is presently considering the possibility of seeking further information regarding the various elements of the GTM, and/or actually using the GTM. And in reference to these possibilities, it should again be mentioned that there are probably as many variations in the specific implementation of each component of the GTM as there are people using it. But the four fundamental ideas [of (l) specifying behavioral objectives, (2) preassessing, (3) designing instruction to achieve the objectives, and (4) evaluating the achievement of objectives and continually refining each component to maximize instructional efficiency] appear to be common to all applications of the GTM.

Alternative Models of Teaching



One criticism which has been leveled at earlier presentations of the GTM is that no alternative models of teaching have been offered. The essential reason that other models have not been presented is that the writers consider the GTM better than any others with which they are familiar. And perhaps by showing several alternative models, the reason for this conviction may become more evident.

Any of the models shown is perfectly valid if the teacher is not concerned with the effectiveness of his/her teaching. In all fairness, it must be admitted that an approach such as model No. 1 has some appealing qualities. Here the teacher only takes the responsibility for offering instruction - whether what is presented is relevant to the student, or whether the student learns, is up to the student. The teacher is much like a book or film which the student can select and gain much or little from. Perhaps the most appealing thing about this model is that it would seem to foster a good deal of responsibility and a minimum of teacher dependence with the student. If one's goal was to produce students who are self-motivated, self-directed, and self-evaluating, then such a model might appear to be the best one available. Unfortunately, however, without specifying objectives, pre-assessing or evaluating, one could never determine whether the instruction was effective.

Of the five alternative models, numbers two and four may be the most commonly used. In number two the instructor usually decides what to teach on the basis of what he/she knows well, or what is of interest to him/her. Then after instruction, he/she evaluates how much his/her students learned. Based on your present knowledge of the GTM, the inadequacies of this and the other alternative models should be apparent.

Hopefully, it has been made clear that the successful application of the GTM does not involve the application of one simple formula. As a matter of fact, instead of simplifying the task for the teacher, it very likely increases the complexity of teaching and perhaps requires more creativity and resourcefulness than is required by any other approach to the design and implementation of instruction.

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Additional Note:

The article on the General Teaching Model is included in this book of readings, not because it focuses directly on environmental education, but because it focuses on education. And, environmental education cannot be considered "good" environmental education, unless it is first and foremost "good education". The GTM permits the instructional planner to ask (and consider) the questions, "What should the student accomplish? " . . . "What activities will be provided to permit the student to accomplish this?" . . . "How will I ascertain the level of student accomplishment?". The GTM is a component of what Ramsey refers to as "system organization", and as such simply leads the instructional planner (on a small scale) and the curriculum planner (on a larger scale) to provide the learner with instruction or curricula which is consistent across it components. The GTM does not dictate WHAT is to be taught, HOW it is to be taught, or HOW it is to be evaluated. Its greatest contribution is that it assists the planner in providing for a thorough and systematic approach to curriculum and instruction.